REPORT NUMBER 138-STF-20-002

SAFETY COMPLIANCE TESTING FOR FMVSS NO. 138 TIRE PRESSURE MONITORING SYSTEMS

BAYERISCHE MOTOREN WERKE AG
2020 BMW 330i
FOUR-DOOR PASSENGER CAR
NHTSA NO. C20204100

U.S. DOT SAN ANGELO TEST FACILITY
131 COMANCHE TRAIL, BUILDING 3527
GOODFELLOW AFB, TEXAS 76908

February 26, 2020

FINAL REPORT

PREPARED FOR

U.S. DEPARTMENT OF TRANSPORTATION
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION
ENFORCEMENT
NEF-200
OFFICE OF VEHICLE SAFETY COMPLIANCE
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Technical Report Documentation Page

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SECTION 1

INTRODUCTION

1.1 PURPOSE OF COMPLIANCE TEST

This testing was conducted as part of the Department of Transportation, National Highway Traffic Safety Administration's Federal Motor Vehicle Safety Standard (FMVSS) No. 138, "Tire Pressure Monitoring Systems" Compliance Program. The purpose of the test was to determine if the 2020 BMW 330i supplied by the Office of Vehicle Safety Compliance satisfies the requirements of TP-138-04 dated August 28, 2017.

1.2 TEST VEHICLE

The test vehicle was a 2020 BMW 330i. Nomenclatures applicable to the test vehicle are:

A. Vehicle Identification Number: WBA5R1C0XLFH53825

B. NHTSA Number: C20204100

C. Manufacturer: Bayerische Motoren Werke AG

D. Manufacture Date: 07/2019

1.3 TEST DATE

The test vehicle was tested January 16, 2020 thru February 24, 2020

SECTION 2

TEST PROCEDURE AND SUMMARY OF RESULTS

2.1 TEST PROCEDURE

Prior to test, the test vehicle was inspected for completeness, systems operability, and appropriate fuel and liquid levels, i.e. oil and coolant. The vehicle was then photographically documented as required by the NHTSA/OVSC Test Procedure. Tire sidewall and vehicle labeling information were recorded. The owner's manual was reviewed, and pertinent tire and TPMS information were noted. Telltale's symbol, color, location, and lamp function were checked.

Subsequent events included weighing the vehicle to establish the Unloaded Vehicle Weight (UVW) and the distribution of weight on the front and rear axles and each wheel position. The vehicle was loaded to its Lightly Loaded Vehicle Weight (LLVW) for three tire deflation scenarios. This LLVW included the UVW and the weights of the driver, one passenger, and test equipment. The vehicle was loaded to its UVW plus Vehicle Capacity Weight (VCW) for two additional tire deflation scenarios. The VCW included the weights of the driver, one passenger, test equipment, ballast in the mid seat, rear seat, and the rear cargo area as applicable. The vehicle is required to be loaded to its maximum capacity without exceeding either the Vehicle Capacity Weight or Gross Vehicle Weight Rating (GVWR). For determination of the telltale warning activation pressure, the recommended cold inflation pressure was identified from the vehicle placard.

The vehicle was instrumented with a Racelogic VBOX 3iSL 100 Hz GPS Data Logger and brake pedal trigger. The VBOX uses GPS to measure vehicle speed, time, and distance. Test data were recorded to a compact flash card. During the test, a stopwatch was used to determine the approximate "cumulative driving time" during each test phase. Cumulative driving time does not include time during the brake application or when the vehicle speed was below 50 km/h or above 100 km/h. Upon completion of a tire deflation scenario, graphs were generated by VBOX software showing vehicle speed versus time during the test procedures. The graphs furnish a second by second analysis of each calibration and low inflation pressure detection phase (as appropriate). The cumulative driving time was calculated by post-processing the VBOX graph data, and is reported in Section 3 (Test Data) as 'Total Cumulative Driving Time'.

The low tire pressure test scenarios consisted of five phases, in accordance with FMVSS 138, Test Procedures, Section S6:

1. Lamp Check Phase, S6(a) through (c): With the vehicle stationary and the ignition locking system in the "Lock" or "Off" position, the tires were set at the vehicle's placard cold inflation pressure and the ignition locking system was activated to the "On" ("Run") position. The ignition locking system can also be initially positioned as designated by the manufacturer as a check position. If applicable, the set/reset button was used to reset the TPMS system in accordance with the instructions in the vehicle owner's manual.
2. Calibration Phase, S6(d): The vehicle was driven for at least twenty minutes of cumulative driving time between 50 and 100 km/h. Immediately after, the selected tire(s) were deflated to seven kPa (one psi) below the Telltale Warning

Activation Pressure. After one minute, the inflation pressure(s) of only deflated tire(s) were rechecked and adjusted if necessary.

3. Detection Phase, S6(f): The vehicle was started and driven (if necessary) to ensure that the low inflation pressure telltale illuminated. The test is discontinued if no illumination occurs.
4. Re-illumination Phase, S6(g) through (h): Vehicle was parked in the San Angelo Test Facility (SATF) open bay shielded from direct sunlight and the ignition locking system deactivated to the "Off" or "Lock" position. Tires were allowed to cool down for a minimum of one hour. After cool down, the vehicle was started and the low tire pressure telltale was checked for re-illumination.
5. Extinguishment Phase, S6(i): Tires were adjusted to vehicle placard cold inflation pressure. If the vehicle has a manual reset, the set/reset button was used to reset the TPMS system illumination. The system was reset as required by the owner's manual instructions or manufacturer's supplied information. If necessary, the vehicle was driven to ensure that the TPMS telltale is extinguished.

Five gradual deflation test scenarios, Section 13.4 of Test Procedures of FMVSS 138, followed the steps for the low tire pressure test above except that:

Calibration Phase: The vehicle was driven for 20 to 22 minutes of cumulative driving time between 50 and 100 km/h. Immediately after, the selected tire(s) were deflated to fourteen kPa (two psi) below the Recommended Cold Inflation Pressure(s). After one minute, the inflation pressure(s) of only deflated tire(s) were rechecked and adjusted if necessary.

Detection Phase: The vehicle was started and driven for 20 to 22 minutes at speeds between 50 and 100 km/h to determine if the low inflation pressure telltale illuminated. If no illumination occurred, the selected tire(s) were deflated an additional fourteen kPa (two psi) and after one minute, the pressure(s) were rechecked and adjusted if necessary. The cycle of fourteen kPa deflation was repeated until illumination occurred. Testing would have stopped if illumination had not occurred before deflation pressures reached more than 33% below the manufacturer's recommended cold inflation pressure threshold.

The two malfunction scenarios performed were: the TPMS right front Sensor was removed at LLVW and the FBD4 Module (RF receiver for TPMS Sensors) was disconnected at UVW+VCW.

2.2 SUMMARY OF RESULTS

Three tire deflation scenarios were performed on the test vehicle at LLVW:

A. Left front
B. Left front and left rear
C. Left front, left rear, right rear, and right front

Two tire deflation scenarios were performed on the test vehicle at UVW+VCW:

D. Left front and right front
E. Left rear, right rear, and right front

The data indicate compliance of the test vehicle's tire pressure monitoring system for the five tire deflation scenarios tested.

Three gradual deflation scenarios were performed on the test vehicle at LLVW:

Gradual Deflation 1: Left front
Gradual Deflation 2: Left rear and right front
Gradual Deflation 3: Left front, left rear, and right rear

Two gradual deflation scenarios were performed on the test vehicle at UVW+VCW:

Gradual Deflation 4: Right rear
Gradual Deflation 5: Right rear and right front

The data indicate compliance of the test vehicle's tire pressure monitoring system for the five gradual deflation scenarios tested.

One malfunction detection scenario was performed on the test vehicle at LLVW:

Malfunction 1: TPMS right front sensor was removed

One malfunction detection scenario was performed on the test vehicle at UVW+VCW:

Malfunction 2: Disconnected FBD4 Module (RF receiver for TPMS Sensors)

The data indicates that the vehicle's TPMS meets the malfunction requirements.

*An approved alternative route was used for FMVSS 138 testing due to the closing of the North Gate by GAFB. The alternative route was evaluated and verified to produce equivalent scenarios as the original route prior to testing.

SECTION 3

TEST DATA

FMVSS No. 138 – TEST DATA SUMMARY

TEST DATES: January 16 thru February 24, 2020

LAB: U.S. DOT San Angelo Test Facility VEHICLE NHTSA NUMBER: C20204100

VIN: WBA5R1C0XLFH53825 CERTIFICATION LABEL BUILD DATE: 07/2019

REQUIREMENTS	**PASS/FAIL**
LOW TIRE PRESSURE WARNING TELLTALE S138: S4.3.1 (a), (b); S4.3.3 (a), (b)	
Mounting	**PASS**
Symbol and color	**PASS**
Check of lamp function	**PASS**
MALFUNCTION TELLTALE S138: S4.4 (b) or (c)	
Mounting	**PASS**
Symbol and color	**PASS**
Check of lamp function	**PASS**
LOW TIRE PRESSURE WARNING - OPERATIONAL PERFORMANCE S138: S4.2, S4.3.1 (c), S4.3.2	
Telltale illumination	**PASS**
MALFUNCTION INDICATOR – OPERATIONAL PERFORMANCE S138: S4.4 (a)	
Telltale illumination	**PASS**
TPMS WRITTEN INSTRUCTIONS S138: S4.5	
Image of telltales	**PASS**
Verbatim statements	**PASS**

REMARKS: None

TEST PREPARATION INFORMATION
DATA SHEET 1 (Sheet 1 of 3)

TEST DATE: February 24, 2020 LAB: U.S. DOT San Angelo Test Facility

VEHICLE NHTSA NUMBER: C20204100 VIN: WBA5R1C0XLFH53825

CERTIFICATION LABEL BUILD DATE: 07/2019 ENGINE: 2.0L, 4-cylinder

MY/MAKE/MODEL/BODY STYLE: 2020 BMW 330i 4-door passenger car

TIRE CONDITIONING:

(X) Tires used more than 100 km. Actual odometer reading: 63 mi (101.4 km)

VEHICLE ALIGNMENT AND WHEEL BALANCING:

Alignment checked: ( ) Front ( ) Rear (X) COR waived

Wheels balanced: ( ) Front ( ) Rear (X) COR waived

TPMS IDENTIFICATION:

TPMS MAKE/MODEL: Sensors – HUF 36 10 6 877 937

Source: Manufacturer supplied information

TPMS TYPE: (X) Direct ( ) Indirect ( ) Other

Does TPMS require execution of a learning/calibration driving phase? (X)YES ( )NO

Source: Manufacturer supplied information

Does TPMS have a manual reset control? ( )YES (X)NO

TPMS MALFUNCTION INDICATOR TYPE:

( ) None ( ) Dedicated Telltale (X) Combination low tire pressure/malfunction telltale

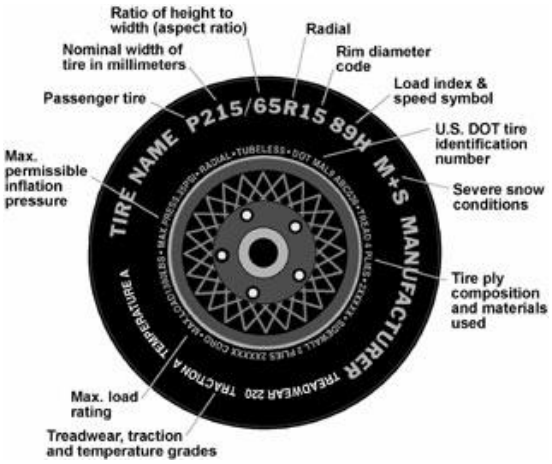
TEST PREPARATION INFORMATION
DATA SHEET 1 (Sheet 2 of 3)

DESIGNATED TIRE SIZE(S) FROM VEHICLE LABELING AND OWNER'S MANUAL:

Axle	Tire Size	Recommended Cold Inflation Pressure	Source
Front	225/45R18	220 kPa, 32 psi	Vehicle placard
Rear	225/45R18	260 kPa, 38 psi	Vehicle placard

INSTALLED TIRE DATA

Diagram – Passenger Car Tire Labeling



Front and Rear Axles

Tire Size and Load Index / Speed Rating: 225/45R18 95 H

Manufacturer/Tire Name: Pirelli Cinturato P7

Sidewall Max Load Rating: 690 kg, 1,521 lbs.

Max Inflation Pressure: 340 kPa, 49 psi

Sidewall Construction (number of plies and ply material): 1 rayon

Tread Construction (number of plies and ply material): 1 rayon, 2 steel, 1 polyamide

Do all installed tires have the same sidewall information? (X)YES ( )NO

Are all installed tires the same as designated by the vehicle manufacturer on the vehicle placard? (X)YES ( )NO

TEST PREPARATION INFORMATION
DATA SHEET 1 (Sheet 3 of 3)

Worksheet for Determining FMVSS No. 138 Telltale Warning Activation Pressure for Tires Installed on Vehicle		
Part	**Front Axle**	**Rear Axle**
(A) Recommended Inflation Pressure x .75	220 kPa x .75 = 165.0 kPa	260 kPa x .75 = 195.0 kPa
(B) Information from FMVSS 138 Table 1 below, Tire types are:	( ) P-metric-Standard load (X) P-metric-Extra Load Load Range ( ) C, ( ) D, or ( ) E	( ) P-metric-Standard load (X) P-metric-Extra Load Load Range ( ) C, ( ) D, or ( ) E
Inflation pressure	(X) Maximum or ( ) Rated	(X) Maximum or ( ) Rated
Minimum activation pressures from Table 1	340 kPa 160 kPa	340 kPa 160 kPa
(C) Telltale Warning Activation Pressure is the higher of Part (A) or (B)	165.0 kPa	195.0 kPa
(D) Pressure at which to deflate tire(s) = (C) – 7 kPa	158.0 kPa	188.0 kPa

FMVSS 138 Table 1 - Low Tire Pressure Warning Telltale - Minimum Activation Pressure

Tire Type	**Maximum or Rated Inflation Pressure**		**Minimum Activation Pressure**	
	(kPa)	**(psi)**	**(kPa)**	**(psi)**
P-metric -- Standard Load	240, 300, or 350	35, 44, or 51	140 140 140	20 20 20
P-metric -- Extra Load	280 or 340	41 or 49	160 160	23 23
Load Range C	350	51	200	29
Load Range D	450	65	240	35
Load Range E	550	80	240	35

REMARKS: None

RECORDED BY: Anthony Walden & Tommy Oliver DATE: January 16, 2020

APPROVED BY: Jayton Lindley

LOW TIRE PRESSURE WARNING AND MALFUNCTION TELLTALE
DATA SHEET 2 (Sheet 1 of 2)

TEST DATE: February 24, 2020 LAB: U.S. DOT San Angelo Test Facility

VEHICLE NHTSA NUMBER: C20204100

TPMS Low Tire Pressure Warning Telltale

Telltale is mounted inside the occupant compartment in front of and in clear view of the driver?

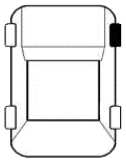
(X)YES ( )NO (fail)

TPMS Low Tire Pressure Warning Telltale Location: Left of tachometer by 500 rpm indicator

Identify Telltale Symbol Used (check box above figure).

[X]

[ ]



[ ]

OTHER (fail)
(describe below)

Note any words or additional symbols used: NONE

Telltale is part of a reconfigurable display? ( )YES (X)NO

TPMS Malfunction Telltale

( ) None ( ) Dedicated stand-alone (X) Combined with low tire pressure telltale

Note any words or additional symbols used: None

LOW TIRE PRESSURE WARNING AND MALFUNCTION TELLTALE
DATA SHEET 2 (Sheet 2 of 2)

Check Telltale Lamp Functions:

LOW TIRE PRESSURE WARNING AND MALFUNCTION TELLTALE

Ignition locking system position when telltale illuminates:

[ ]	OFF/LOCK	[ ]	Between OFF/LOCK and ON/RUN
[ ]	ON/RUN	[X]	START

Is the telltale yellow in color? (X)YES ( )NO (fail)

Time telltale remains illuminated 4 seconds.

Starter Interlocks:

Does vehicle have any starter, transmission or other interlocks that affect operation of the telltale lamp check function? (X)YES ( )NO

Describe the interlock features: Brake pedal must be depressed for vehicle ignition

Low Tire Pressure Warning and Malfunction Telltales (PASS/FAIL) **PASS**

REMARKS: None

RECORDED BY: Anthony Walden & Tommy Oliver DATE: February 24, 2020

APPROVED BY: Jayton Lindley

TPMS OPERATIONAL PERFORMANCE
DATA SHEET 3 (Sheet 1 of 64)

TEST DATE: January 16, 2020 LAB: U.S. DOT San Angelo Test Facility

VEHICLE NHTSA NUMBER: C20204100

Time: Start: 9:40 am End: 9:59 am

Ambient Temperature: Start: 20.2°C End: 20.9°C

Trip Odometer Reading: Start: 63 mi

Fuel Level: Start: Full

Weather Conditions: Indoors

Time vehicle remained with engine off and tires shielded from direct sunlight (1-hour minimum): overnight

PRE-TEST TIRE INFLATION PRESSURES AND TIRE/SURFACE TEMPERATURES:

Execution Procedure	LF Tire	LR Tire	RR Tire	RF Tire
Pre-test cold measurements after ambient soak: Inflation Pressure	220.0 kPa	260.0 kPa	260.0 kPa	220.0 kPa
Tire Sidewall Temp	20.6°C	20.0°C	20.4°C	20.6°C

TPMS OPERATIONAL PERFORMANCE
DATA SHEET 3 (Sheet 2 of 64)

VEHICLE WEIGHT:

Vehicle Ratings from Certification Label:

GVWR: 2,080 kg, 4,586 lbs.

GAWR (front): 995 kg, 2,194 lbs.

GAWR (rear): 1,160 kg, 2,557 lbs.

Vehicle Capacity Weight from Vehicle Placard:

Vehicle Capacity Weight: 375 kg, 827 lbs.

Measured Unloaded Vehicle Weight:

LF	404.0 kg	LR	389.0 kg
RF	413.5 kg	RR	389.0 kg
Front Axle	817.5 kg	Rear Axle	778.0 kg

Total Vehicle 1,595.5 kg

Measured Test Weight: (X) LLVW (+50, - 0 kg) ( ) UVW+VCW ( ) GVWR (+0, -50 kg)

LF	452.5 kg	LR	441.0 kg
RF	456.0 kg	RR	440.0 kg
Front Axle	908.5 kg (≤ GAWR)	Rear Axle	881.0 kg (≤ GAWR)

Total Vehicle 1,789.5 kg (not greater than GVWR)

Note: For Scenarios A, B, and C, Malfunction 1, and Gradual Deflations 1, 2, and 3, this Total Vehicle Weight measures the vehicle loaded to Lightly Loaded Vehicle Weight (LLVW). This consisted of the Unloaded Vehicle Weight (UVW) and 194.0 kg of driver, passenger, and test equipment.

RECORDED BY: Anthony Walden & Tommy Oliver DATE: January 16, 2020

APPROVED BY: Jayton Lindley

TPMS OPERATIONAL PERFORMANCE
DATA SHEET 3 (Sheet 3 of 64)

NORMAL DEFLATION TEST, SCENARIO A – Left Front Tire Deflation at LLVW

TEST DATE: January 21, 2020 LAB: U.S. DOT San Angelo Test Facility

VEHICLE NHTSA NUMBER: C20204100

Note: See Data Sheet 3 (Sheet 2 of 64) for Test Weight.

TIRE INFLATION PRESSURES AND TIRE/SURFACE TEMPERATURES BEFORE CALIBRATION PHASE:

Execution Procedure	LF Tire	LR Tire	RR Tire	RF Tire
After loading vehicle to LLVW, positioning vehicle at selected test start point, and vehicle cool down period: Ambient Temperature: 11.7°C Vehicle cool down period: overnight				
Inflation Pressure	220.0 kPa	260.0 kPa	260.0 kPa	220.0 kPa
Tire Sidewall Temp	13.2°C	11.6°C	12.6°C	13.8°C
San Angelo Test Facility Shop Floor Temp	15.8°C	14.8°C	15.2°C	16.0°C

SYSTEM CALIBRATION/LEARNING PHASE:

Time: Start: 15:15:08 UTC End: 15:43:32 UTC

Trip Odometer Reading: Start: 66.1 mi End: 87.0 mi

Ambient Temperature: Start: 11.2°C End: 11.8°C

Roadway Temperature: Start: 8.4°C End: 9.8°C

Weather Conditions: Cool, cloudy, & breezy

Driving in first direction:

Starting point: GAFB South Gate Direction: see chart, page 99

11:42 minutes (cumulative stopwatch time) 11.9 mi distance

Driving in opposite direction:

Starting point: US Hwy 87 crossover overpass Direction: see chart, page 99

9:27 minutes (cumulative stopwatch time) 9.0 mi distance

Max speed: 105.44 km/h

Total Cumulative Driving Time: 21:10 minutes (VBOX processed data)

TPMS OPERATIONAL PERFORMANCE
DATA SHEET 3 (Sheet 4 of 64)

NORMAL DEFLATION TEST, SCENARIO A – Left Front Tire Deflation at LLVW

TIRE INFLATION PRESSURES AND TEMPERATURES AFTER CALIBRATION PHASE:

Execution Procedure	LF Tire	LR Tire	RR Tire	RF Tire
Immediately, after vehicle is stopped, engine off: Inflation Pressure	234.0 kPa	274.5 kPa	275.0 kPa	236.0 kPa
Tire Sidewall Temp	21.8°C	15.8°C	15.6°C	20.0°C
San Angelo Test Facility Shop Floor Temp	8.4°C	7.8°C	7.0°C	7.2°C

SYSTEM DETECTION PHASE:

LOCATION AND PRESSURE(S) OF DEFLATED TIRE(S):

Execution Procedure	LF Tire	LR Tire	RR Tire	RF Tire
Indicate Location of Tire(s) Deflated: (**X**)LF ( )LR ( )RR ( )RF Inflation Pressure	158.0 kPa			

TELLTALE ILLUMINATION:

Starting point: GAFB South Gate Direction: see chart, page 100

Total distance to Illumination: 0.8 mi

Time to illumination: 0:45 seconds (cumulative stopwatch time)

Max Speed: 74.02 km/h

Total Cumulative Driving Time: 0:46 seconds (VBox processed data)

Does the vehicle identify which tire(s) is (are) under-inflated?

( )YES (X)NO If yes: ( )Telltale ( )Reconfigurable Display

TELLTALE ILLUMINATES WITHIN 20 MINUTES: (X)YES ( )NO (fail)

After 5 minutes with the ignition locking system in the “Off” or “Lock” position, does the telltale re-illuminate and stay illuminated when the ignition locking system is activated to the “On” or “Run” position? ( )YES (X)NO

Deactivate the ignition locking system and then re-start the vehicle engine. Does the telltale re-illuminate and stay illuminated when the ignition locking system is activated to the “On” or “Run” position? (X)YES ( )NO (fail)

TPMS OPERATIONAL PERFORMANCE
DATA SHEET 3 (Sheet 5 of 64)

NORMAL DEFLATION TEST, SCENARIO A – Left Front Tire Deflation at LLVW

TIRE INFLATION PRESSURES AND TEMPERATURES AFTER TELLTALE ILLUMINATION:

Execution Procedure	LF Tire	LR Tire	RR Tire	RF Tire
After vehicle cool down period: Ambient Temperature: 12.7°C Vehicle cool down period: 71 minutes				
Inflation Pressure	154.6 kPa	262.0 kPa	262.9 kPa	226.8 kPa
Tire Sidewall Temp	18.4°C	14.2°C	15.2°C	18.4°C
San Angelo Test Facility Shop Floor Temp	16.4°C	14.8°C	15.4°C	16.0°C

After the cool down period of a minimum of one hour, does the telltale re-illuminate and stay illuminated when the ignition locking system is activated to the “On” or “Run” position?

( )YES (X)NO

TELLTALE EXTINGUISHMENT:

RE-ADJUSTED TIRE INFLATION PRESSURES:

Execution Procedure	LF Tire	LR Tire	RR Tire	RF Tire
After illumination verification: Re-adjusted Inflation Pressure:	220.0 kPa	260.0 kPa	260.0 kPa	220.0 kPa

Is it necessary to use a set/reset button to extinguish the low tire pressure telltale?
( )YES ( )NO (X)N/A

Is it necessary to drive the vehicle to extinguish the telltale? ( )YES (X)NO

Starting point: N/A

Total distance to extinguishment: N/A

Time to extinguishment: N/A minutes (non-cumulative stopwatch time)

TEST RESULTS

TPMS Performance Test Results (PASS/FAIL) **PASS**
Left front tire was deflated at LLVW

REMARKS: An alternative route was used due to north gate closure by GAFB

RECORDED BY: Anthony Walden & Tommy Oliver DATE: January 21, 2020

APPROVED BY: Jayton Lindley

TPMS OPERATIONAL PERFORMANCE
DATA SHEET 3 (Sheet 6 of 64)

NORMAL DEFLATION TEST, SCENARIO B
Left Front and Left Rear Tire Deflation at LLVW

TEST DATE: January 22, 2020 LAB: U.S. DOT San Angelo Test Facility

VEHICLE NHTSA NUMBER: C20204100

Note: See Data Sheet 3 (Sheet 2 of 64) for Test Weight.

TIRE INFLATION PRESSURES AND TIRE/SURFACE TEMPERATURES BEFORE CALIBRATION PHASE:

Execution Procedure	LF Tire	LR Tire	RR Tire	RF Tire
After loading vehicle to LLVW, positioning vehicle at selected test start point, and vehicle cool down period: Ambient Temperature: 12.2°C Vehicle cool down period: overnight				
Inflation Pressure	220.0 kPa	260.0 kPa	260.0 kPa	220.0 kPa
Tire Sidewall Temp	12.6°C	11.8°C	12.0°C	12.8°C
San Angelo Test Facility Shop Floor Temp	14.8°C	13.8°C	14.2°C	15.0°C

SYSTEM CALIBRATION/LEARNING PHASE:

Time: Start: 15:05:48 UTC End: 15:33:29 UTC

Trip Odometer Reading: Start: 91.9 mi End: 112.9 mi

Ambient Temperature: Start: 12.2°C End: 12.2°C

Roadway Temperature: Start: 10.4°C End: 9.4°C

Weather Conditions: Cloudy, cool, & breezy

Driving in first direction:

Starting point: GAFB South Gate Direction: see chart, page 101

11:51 minutes (cumulative stopwatch time) 11.9 mi distance

Driving in opposite direction:

Starting point: US Hwy 87 crossover overpass Direction: see chart, page 101

8:50 minutes (cumulative stopwatch time) 9.1 mi distance

Max speed: 93.39 km/h

Total Cumulative Driving Time: 20:46 minutes (VBOX processed data)

TPMS OPERATIONAL PERFORMANCE
DATA SHEET 3 (Sheet 7 of 64)

NORMAL DEFLATION TEST, SCENARIO B
Left Front and Left Rear Tire Deflation at LLVW

TIRE INFLATION PRESSURES AND TEMPERATURES AFTER CALIBRATION PHASE:

Execution Procedure	LF Tire	LR Tire	RR Tire	RF Tire
Immediately, after vehicle is stopped, engine off: Inflation Pressure	233.8 kPa	274.9 kPa	278.1 kPa	236.1 kPa
Tire Sidewall Temp	20.2°C	15.6°C	17.6°C	23.2°C
San Angelo Test Facility Shop Floor Temp	10.2°C	9.2°C	9.4°C	9.4°C

SYSTEM DETECTION PHASE:

LOCATION AND PRESSURE(S) OF DEFLATED TIRE(S):

Execution Procedure	LF Tire	LR Tire	RR Tire	RF Tire
Indicate Location of Tire(s) Deflated: (**X**)LF (**X**)LR ( )RR ( )RF Inflation Pressure	158.0 kPa	188.0 kPa		

TELLTALE ILLUMINATION:

Starting point: Driving Not Necessary Direction: N/A

Total distance to Illumination: N/A

Time to illumination: N/A minutes (cumulative stopwatch time)

Max Speed: N/A

Total Cumulative Driving Time: N/A minutes (VBox processed data)

Does the vehicle identify which tire(s) is (are) under-inflated?

( )YES (X)NO If yes: ( ) Telltale ( ) Reconfigurable Display

TELLTALE ILLUMINATES WITHIN 20 MINUTES: (X)YES ( )NO (fail)

After 5 minutes with the ignition locking system in the “Off” or “Lock” position, does the telltale re-illuminate and stay illuminated when the ignition locking system is activated to the “On” or “Run” position? ( )YES (X)NO

Deactivate the ignition locking system and then re-start the vehicle engine. Does the telltale re-illuminate and stay illuminated when the ignition locking system is activated to the “On” or “Run” position? (X)YES ( )NO (fail)

TPMS OPERATIONAL PERFORMANCE
DATA SHEET 3 (Sheet 8 of 64)

NORMAL DEFLATION TEST, SCENARIO B
Left Front and Left Rear Tire Deflation at LLVW

TIRE INFLATION PRESSURES AND TEMPERATURES AFTER TELLTALE ILLUMINATION:

Execution Procedure	LF Tire	LR Tire	RR Tire	RF Tire
After vehicle cool down period: Ambient Temperature: 15.4°C Vehicle cool down period: 66 minutes				
Inflation Pressure	152.9 kPa	182.2 kPa	262.3 kPa	223.6 kPa
Tire Sidewall Temp	15.8°C	13.4°C	13.8°C	16.6°C
San Angelo Test Facility Shop Floor Temp	14.8°C	13.8°C	14.2°C	15.2°C

After the cool down period of a minimum of one hour, does the telltale re-illuminate and stay illuminated when the ignition locking system is activated to the "On" or "Run" position?
(X)YES ( )NO (fail)

TELLTALE EXTINGUISHMENT:

RE-ADJUSTED TIRE INFLATION PRESSURES:

Execution Procedure	LF Tire	LR Tire	RR Tire	RF Tire
After illumination verification: Re-adjusted Inflation Pressure:	220.0 kPa	260.0 kPa	260.0 kPa	220.0 kPa

Is it necessary to use the set/reset button to extinguish the low tire pressure telltale?
( )YES ( )NO (X)N/A

Is it necessary to drive the vehicle to extinguish the telltale? ( )YES (X)NO

Starting point: Driving Not Necessary

Total distance to extinguishment: N/A

Time to extinguishment: N/A minutes (non-cumulative stopwatch time)

TEST RESULTS

TPMS Performance Test Results (PASS/FAIL) **PASS**
Left front and left rear tires were deflated at LLVW

REMARKS: An alternative route was used due to north gate closure by GAFB

RECORDED BY: Anthony Walden & Tommy Oliver DATE: January 22, 2020

APPROVED BY: Jayton Lindley

TPMS OPERATIONAL PERFORMANCE
DATA SHEET 3 (Sheet 9 of 64)

NORMAL DEFLATION TEST, SCENARIO C
Left Front, Left Rear, Right Rear, and Right Front Tire Deflation at LLVW

TEST DATE: January 22, 2020 LAB: U.S. DOT San Angelo Test Facility

VEHICLE NHTSA NUMBER: C20204100

Note: See Data Sheet 3 (Sheet 2 of 64) for Test Weight.

TIRE INFLATION PRESSURES AND TIRE/SURFACE TEMPERATURES BEFORE CALIBRATION PHASE:

Execution Procedure	LF Tire	LR Tire	RR Tire	RF Tire
After loading vehicle to LLVW, positioning vehicle at selected test start point, and vehicle cool down period: Ambient Temperature: 15.8°C Vehicle cool down period: 105 minutes				
Inflation Pressure	220.0 kPa	260.0 kPa	260.0 kPa	220.0 kPa
Tire Sidewall Temp	16.4°C	14.8°C	16.0°C	16.8°C
San Angelo Test Facility Shop Floor Temp	15.6°C	15.2°C	15.6°C	16.2°C

SYSTEM CALIBRATION/LEARNING PHASE:

Time: Start: 18:42:07 UTC End: 19:09:29 UTC

Trip Odometer Reading: Start: 115.3 mi End: 136.3 mi

Ambient Temperature: Start: 15.7°C End: 16.9°C

Roadway Temperature: Start: 25.4°C End: 18.5°C

Weather Conditions: Partly cloudy, cool, & breezy

Driving in first direction:

Starting point: GAFB South Gate Direction: see chart, page 102

11:42 minutes (cumulative stopwatch time) 11.9 mi distance

Driving in opposite direction:

Starting point: US Hwy 87 crossover overpass Direction: see chart, page 102

8:59 minutes (cumulative stopwatch time) 9.1 mi distance

Max speed: 93.32 km/h

Total Cumulative Driving Time: 20:41 minutes (VBOX processed data)

TPMS OPERATIONAL PERFORMANCE
DATA SHEET 3 (Sheet 10 of 64)

NORMAL DEFLATION TEST, SCENARIO C
Left Front, Left Rear, Right Rear, and Right Front Tire Deflation at LLVW

TIRE INFLATION PRESSURES AND TEMPERATURES AFTER CALIBRATION PHASE:

Execution Procedure	LF Tire	LR Tire	RR Tire	RF Tire
Immediately, after vehicle is stopped, engine off: Inflation Pressure	238.1 kPa	279.8 kPa	282.7 kPa	238.4 kPa
Tire Sidewall Temp	29.2°C	24.2°C	25.6°C	27.8°C
San Angelo Test Facility Shop Floor Temp	19.0°C	18.2°C	18.2°C	18.0°C

SYSTEM DETECTION PHASE:

LOCATION AND PRESSURE(S) OF DEFLATED TIRE(S):

Execution Procedure	LF Tire	LR Tire	RR Tire	RF Tire
Indicate Location of Tire(s) Deflated: (**X**)LF (**X**)LR (**X**)RR (**X**)RF Inflation Pressure	158.0 kPa	188.0 kPa	188.0 kPa	158.0 kPa

TELLTALE ILLUMINATION:

Starting point: Driving Not Necessary Direction: N/A

Total distance to Illumination: N/A

Time to illumination: N/A minutes (cumulative stopwatch time)

Max Speed: N/A

Total Cumulative Driving Time: N/A minutes (VBox processed data)

Does the vehicle identify which tire(s) is (are) under-inflated?

( )YES (X)NO If yes: ( ) Telltale ( ) Reconfigurable Display

TELLTALE ILLUMINATES WITHIN 20 MINUTES: (X)YES ( )NO (fail)

After 5 minutes with the ignition locking system in the “Off” or “Lock” position, does the telltale re-illuminate and stay illuminated when the ignition locking system is activated to the “On” or “Run” position? ( )YES (X)NO

Deactivate the ignition locking system and then re-start the vehicle engine. Does the telltale re-illuminate and stay illuminated when the ignition locking system is activated to the “On” or “Run” position? (X)YES ( )NO (fail)

TPMS OPERATIONAL PERFORMANCE
DATA SHEET 3 (Sheet 11 of 64)

NORMAL DEFLATION TEST, SCENARIO C
Left Front, Left Rear, Right Rear, and Right Front Tire Deflation at LLVW

TIRE INFLATION PRESSURES AND TEMPERATURES AFTER TELLTALE ILLUMINATION:

Execution Procedure	LF Tire	LR Tire	RR Tire	RF Tire
After vehicle cool down period: Ambient Temperature: 18.5.°C Vehicle cool down period: 63 minutes				
Inflation Pressure	152.1 kPa	181.1 kPa	180.1 kPa	152.6 kPa
Tire Sidewall Temp	21.8°C	19.6°C	20.6°C	21.6°C
San Angelo Test Facility Shop Floor Temp	17.4°C	17.2°C	17.4°C	17.4°C

After the cool down period of a minimum of one hour, does the telltale re-illuminate and stay illuminated when the ignition locking system is activated to the "On" or "Run" position?
(X)YES ( )NO (fail)

TELLTALE EXTINGUISHMENT:

RE-ADJUSTED TIRE INFLATION PRESSURES:

Execution Procedure	LF Tire	LR Tire	RR Tire	RF Tire
After illumination verification: Re-adjusted Inflation Pressure:	220.0 kPa	260.0 kPa	260.0 kPa	220.0 kPa

Is it necessary to use the set/reset button to extinguish the low tire pressure telltale?
( )YES ( )NO (X)N/A

Is it necessary to drive the vehicle to extinguish the telltale? (X)YES ( )NO

Starting point: San Angelo Test Facility shop

Total distance to extinguishment: 0.2 mi

Time to extinguishment: 1:22 minutes (non-cumulative stopwatch time)

TEST RESULTS

TPMS Performance Test Results (PASS/FAIL) **PASS**
Left front, left rear, right rear, and right front tires were deflated at LLVW

REMARKS: An alternative route was used due to north gate closure by GAFB

RECORDED BY: Anthony Walden & Tommy Oliver DATE: January 22, 2020

APPROVED BY: Jayton Lindley

TPMS OPERATIONAL PERFORMANCE
DATA SHEET 3 (Sheet 12 of 64)

MALFUNCTION DETECTION TEST 1 –
TPMS Right Front Sensor Removed at LLVW

TEST DATE: January 28, 2020 LAB: U.S. DOT San Angelo Test Facility

VEHICLE NHTSA NUMBER: C20204100

Time:	Start:	9:15 am	End:	1:42 pm
Trip Odometer Reading:	Start:	150.5 mi	End:	159.9 mi
Ambient Temperature:	Start:	13.1°C	End:	10.1°C

Note: See Data Sheet 3 (Sheet 2 of 64) for Test Weight.

TPMS TYPE: (X) Direct ( ) Indirect ( ) Other Describe: _____

TPMS MALFUNCTION TELLTALE:
( ) Dedicated stand-alone (X) Combination low tire pressure warning/malfunction telltale

METHOD OF MALFUNCTION SIMULATION:

Describe method of malfunction simulation: TPMS Right Front sensor was removed (see Figure 5.14)

MALFUNCTION TELLTALE ILLUMINATION
(after ignition locking system is activated to "On" ("Run") position):

Combination Malfunction Telltale

Driving in first direction:

TELLTALE ILLUMINATION:

Starting point: San Angelo Test Facility shop Direction: see chart, page 107

Total distance to Illumination: 6.1 mi

Time to illumination: 4.50 minutes (total cumulative driving time)

Max Speed: 93.86

Total Cumulative Driving Time: 4:50 minutes (VBox processed data)

TEST RESULTS

COMBINATION MALFUNCTION TELLTALE ILLUMINATES (FLASHING AND ILLUMINATION SEQUENCE) WITHIN 20 MINUTES:
(X)YES ( )NO

TPMS OPERATIONAL PERFORMANCE
DATA SHEET 3 (Sheet 13 of 64)

MALFUNCTION DETECTION TEST 1 –
TPMS Right Front Sensor Removed at LLVW

After 5 minutes with the ignition locking system in the "Off" or "Lock" position, does the combination low tire pressure/malfunction telltale flash for a period of at least 60 seconds but no longer than 90 seconds, and then remain illuminated when the ignition locking system is activated to the "On" or "Run" position? (X)YES ( )NO

Time, it takes before telltale starts flashing	4	seconds
Time telltale remains flashing	66	seconds
Time telltale remains illuminated (Verified for a minimum of 60 seconds)	60+	seconds

Deactivate the ignition locking system and then re-start the vehicle engine. Does the telltale's illumination sequence repeat when the ignition locking system is activated and the engine running? (X)YES ( )NO (fail)

Extinguishment Phase:

Starting point: Driving Not Necessary

Total distance to extinguishment: N/A

Time to extinguishment: N/A total driving time (non-cumulative stopwatch time)

COMBINATION MALFUNCTION TELLTALE EXTINGUISHED:
(X)YES ( )NO (FAIL)

TPMS MALFUNCTION PERFORMANCE TEST RESULTS (PASS/FAIL) **PASS**
TPMS Right Front sensor was removed

REMARKS: NONE

RECORDED BY: Anthony Walden & Tommy Oliver DATE: January 28, 2020

APPROVED BY: Jayton Lindley

TPMS OPERATIONAL PERFORMANCE
DATA SHEET 3 (Sheet 14 of 64)

GRADUAL DEFLATION TEST 1
Left Front Tire Deflation at LLVW

TEST DATE: January 29, 2020 LAB: U.S. DOT San Angelo Test Facility

VEHICLE NHTSA NUMBER: C20204100

Time:	Start:	10:10 am	End:	1:49 pm
Ambient Temperature:	Start:	9.6°C	End:	12.4°C
Odometer Reading (mi):	Start:	161.8	End:	249.7
Fuel Level:	Start:	Full	End:	3.0 gallons used

Note: See Data Sheet 3 (Sheet 2 of 64) for Test Weight.

Determining FMVSS No. 138 Gradual Deflation Telltale Minimum Warning Activation Pressure for Tires Installed on Vehicle		
Part	**Front Axle**	**Rear Axle**
Recommended Inflation Pressure x .67	220 kPa x .67 = 147.4 kPa	260 kPa x .67 = 174.2 kPa

TIRE INFLATION PRESSURES

Execution Procedure	LF Tire	LR Tire	RR Tire	RF Tire
Pre-test cold measurements after ambient soak	217.9 kPa	258.9 kPa	259.1 kPa	219.6 kPa

TPMS OPERATIONAL PERFORMANCE
DATA SHEET 3 (Sheet 15 of 64)

GRADUAL DEFLATION TEST 1
Left Front Tire Deflation at LLVW

TIRE INFLATION PRESSURES AND TIRE/SURFACE TEMPERATURES BEFORE CALIBRATION PHASE:

Execution Procedure	LF Tire	LR Tire	RR Tire	RF Tire
After loading vehicle to LLVW, positioning vehicle at selected test start point, and vehicle cool down period: Vehicle cool down period: overnight				
Re-adjusted Inflation Pressure	220.0 kPa	260.0 kPa	260.0 kPa	220.0 kPa
Tire Sidewall Temp	11.6°C	10.2°C	8.4°C	10.4°C
San Angelo Test Facility Shop Floor Temp	14.8°C	14.2°C	13.8°C	14.2°C

SYSTEM CALIBRATION/LEARNING PHASE

Driving in first direction:

Starting point: GAFB South Gate Direction: see chart, page 108
Cumulative vehicle driving time (10 – 15 minutes) at a vehicle speed of 75+ 25 km/h excluding time periods when brake pedal is applied.

11:42 minutes 11.9 distance (mi)

Driving in opposite direction:

Starting point: US Hwy 87 crossover overpass Direction: see chart, page 108
Cumulative vehicle driving time (5 - 12 minutes) at a vehicle speed of 75+ 25 km/h excluding time periods when brake pedal is applied.

8:59 minutes 9.0 distance (mi)

Total stopwatch cumulative driving time (20 - 22 minutes) 20:41 minutes

Max speed: 93.67 km/h

Total Cumulative Driving Time (VBOX processed data): 20:34 minutes
(20 - 22 minutes)

TIRE INFLATION PRESSURES AND TEMPERATURES AFTER CALIBRATION PHASE:

Execution Procedure	LF Tire	LR Tire	RR Tire	RF Tire
Immediately, after vehicle is stopped, engine off: Inflation Pressure	234.4 kPa	276.1 kPa	276.7 kPa	234.2 kPa
Tire Sidewall Temp	29.6°C	22.4°C	15.8°C	18.8°C
Roadway Temp	8.6°C	8.0°C	6.8°C	7.2°C

TPMS OPERATIONAL PERFORMANCE
DATA SHEET 3 (Sheet 16 of 64)

GRADUAL DEFLATION TEST 1
Left Front Tire Deflation at LLVW

TIRE PRESSURE & TEMPERATURE DURING LOW INFLATION PRESSURE TEST

Location of Deflated Tire(s)	**(X) LF**	**( ) LR**	**( ) RR**	**( ) RF**
Original Tire Pressures (kPa)	**220.0 kPa**			

Execution Procedure and Item	**LF Tire**	**LR Tire**	**RR Tire**	**RF Tire**
First 14-kPa Deflation Increment	206.0 kPa			
Driving in first direction:				
Cumulative driving time (10 - 15 minutes) 11:42 minutes				
Did low inflation pressure telltale illuminate? Yes ___ No X				
Driving in opposite direction:				
Cumulative driving time (5 - 12 minutes) 8:59 minutes				
Did low inflation pressure telltale illuminate? Yes ___ No X				
Total cumulative driving time (20 - 22 minutes) 20:41 minutes				
Tire Pressures and Temperatures	**LF Tire**	**LR Tire**	**RR Tire**	**RF Tire**
Inflation Pressure	210.7 kPa	280.0 kPa	277.8 kPa	235.4 kPa
Temperature	31.4°C	24.4°C	19.2°C	22.6°C

TPMS OPERATIONAL PERFORMANCE
DATA SHEET 3 (Sheet 17 of 64)

GRADUAL DEFLATION TEST 1
Left Front Tire Deflation at LLVW

TIRE PRESSURE & TEMPERATURE DURING LOW INFLATION PRESSURE TEST

Execution Procedure and Item	**LF Tire**	**LR Tire**	**RR Tire**	**RF Tire**
Second 14-kPa Deflation Increment	192.0 kPa			

Driving in first direction:

Cumulative driving time (10 - 15 minutes) 11:42 minutes

Did low inflation pressure telltale illuminate? Yes ____ No X

Driving in opposite direction:

Cumulative driving time (5 - 12 minutes) 8:59 minutes

Did low inflation pressure telltale illuminate? Yes ____ No X

Total cumulative driving time (20 - 22 minutes) 20:41 minutes

Tire Pressures and Temperatures	**LF Tire**	**LR Tire**	**RR Tire**	**RF Tire**
Inflation Pressure	194.7 kPa	278.8 kPa	279.1 kPa	237.2 kPa
Temperature	32.2°C	23.6°C	19.4°C	22.8°C

TPMS OPERATIONAL PERFORMANCE
DATA SHEET 3 (Sheet 18 of 64)

GRADUAL DEFLATION TEST 1
Left Front Tire Deflation at LLVW

TIRE PRESSURE & TEMPERATURE DURING LOW INFLATION PRESSURE TEST

Execution Procedure and Item	**LF Tire**	**LR Tire**	**RR Tire**	**RF Tire**
Third 14-kPa Deflation Increment	178.0 kPa			
Driving in first direction:				
Cumulative driving time (10 - 15 minutes)	11:42 minutes			
Did low inflation pressure telltale illuminate?		Yes ____	No X	
Driving in opposite direction				
Cumulative driving time (5 - 12 minutes)	8:59 minutes			
Did low inflation pressure telltale illuminate?		Yes ____	No X	
Total cumulative driving time (20 - 22 minutes)	20:41 minute			
Tire Pressures and Temperatures	**LF Tire**	**LR Tire**	**RR Tire**	**RF Tire**
Inflation Pressure	181.4 kPa	279.5 kPa	279.4 kPa	237.4 kPa
Temperature	33.6°C	23.6°C	19.0°C	23.2°C

TPMS OPERATIONAL PERFORMANCE
DATA SHEET 3 (Sheet 19 of 64)

GRADUAL DEFLATION TEST 1
Left Front Tire Deflation at LLVW

TIRE PRESSURE & TEMPERATURE DURING LOW INFLATION PRESSURE TEST

Execution Procedure and Item	**LF Tire**	**LR Tire**	**RR Tire**	**RF Tire**
Fourth 14-kPa Deflation Increment	164.0 kPa			

Driving in first direction:

Non-cumulative driving time (10 - 15 minutes) 0:45 seconds Direction: see chart, page 109

Did low inflation pressure telltale illuminate? Yes X No ____

Driving in opposite direction:

Cumulative driving time (5 - 12 minutes) ____ minutes

Did low inflation pressure telltale illuminate? Yes ____ No ____

Total non-cumulative driving time (20 - 22 minutes) 0:45 seconds

Tire Pressures and Temperatures	**LF Tire**	**LR Tire**	**RR Tire**	**RF Tire**
Inflation Pressure	163.7 kPa	275.8 kPa	277.6 kPa	234.5 kPa
Temperature	28.8°C	21.2°C	28.2°C	23.8°C

Max speed: 74.65 km/h

Total Cumulative Driving Time (VBOX processed data): 0:45 seconds
(20 - 22 minutes)

TPMS OPERATIONAL PERFORMANCE
DATA SHEET 3 (Sheet 20 of 64)

GRADUAL DEFLATION TEST 1
Left Front Tire Deflation at LLVW

TELLTALE ILLUMINATION:

Execution Procedure Paragraph and Item
Did the low inflation pressure warning telltale illuminate before the inflation pressures in the deflated tire(s) reached the low inflation pressure(s) threshold calculated? **__X__ YES (pass) _____ NO**

Does the vehicle identify which tire(s) is (are) under-inflated?
( ) YES (X) NO If yes: ( ) Telltale ( ) Reconfigurable Display

Tire Locations Verified: ( )LF ( )LR ( )RR ( )RF

After 5 minutes with the ignition locking system in the “Off” or “Lock” position, does the telltale re-illuminate and stay illuminated when the ignition locking system is activated to the “On” or “Run” position? ( )YES (X)NO

After ignition locking system deactivation the and vehicle engine re-start, does the telltale re-illuminate and stay illuminated when the ignition locking system is activated to the “On” or “Run” position (i.e. Key-on-Engine-on)?

(X)YES ( )NO (fail)

TIRE INFLATION PRESSURES AND TEMPERATURES AFTER TELLTALE ILLUMINATION:

Execution Procedure Paragraph and Item	**LF Tire**	**LR Tire**	**RR Tire**	**RF Tire**
After vehicle cool down period. Vehicle cool down period: 67 minutes				
Inflation Pressure	156.2 kPa	267.1 kPa	268.6 kPa	228.4 kPa
Tire Sidewall Temp	22.4°C	19.4°C	19.8°C	21.8°C
Roadway Temp	17.8°C	17.2°C	17.2°C	17.4°C

TPMS OPERATIONAL PERFORMANCE
DATA SHEET 3 (Sheet 21 of 64)

GRADUAL DEFLATION TEST 1
Left Front Tire Deflation at LLVW

After the cool down period of approximately one hour, and vehicle engine restart, does the telltale re-illuminate and stay illuminated when the ignition locking system is activated to the "On" or "Run" position? (X)YES ( )NO

TELLTALE EXTINGUISHMENT:

RE-ADJUSTED TIRE INFLATION PRESSURES:

Execution Procedure Paragraph and Item	LF Tire	LR Tire	RR Tire	RF Tire
After cool down period; Re-adjusted Inflation Pressure kPa	220.0 kPa	260.0 kPa	260.0 kPa	220.0 kPa

If vehicle is equipped with a manual reset control, does activation of this control extinguish the telltale?

( )YES ( )NO (X)N/A

Is it necessary to drive the vehicle to extinguish the telltale? ( )YES (X)NO

Starting point: Driving Not Necessary

Total distance to extinguishment: N/A

Time to extinguishment: N/A minutes (non-cumulative stopwatch time)

TPMS PERFORMANCE TEST RESULTS (PASS/FAIL) **PASS**

REMARKS: An alternative route was used due to north gate closure by GAFB

RECORDED BY: Anthony Walden & Tommy Oliver DATE: January 29, 2020

APPROVED BY: Jayton Lindley

TPMS OPERATIONAL PERFORMANCE
DATA SHEET 3 (Sheet 22 of 64)

GRADUAL DEFLATION TEST 2
Left Rear and Right Front Tire Deflation at LLVW

TEST DATE: February 3, 2020 LAB: U.S. DOT San Angelo Test Facility

VEHICLE NHTSA NUMBER: C20204100

Time:	Start:	9:01 am	End:	12:51 pm
Ambient Temperature:	Start:	15.2°C	End:	24.1°C
Odometer Reading (mi):	Start:	249.8	End:	336.2
Fuel Level:	Start:	Full	End:	3.3 gallons used

Note: See Data Sheet 3 (Sheet 2 of 64) for Test Weight.

Determining FMVSS No. 138 Gradual Deflation Telltale Minimum Warning Activation Pressure for Tires Installed on Vehicle		
Part	**Front Axle**	**Rear Axle**
Recommended Inflation Pressure x .67	220 kPa x .67 = 147.4 kPa	260 kPa x .67 = 174.2 kPa

TIRE INFLATION PRESSURES

Execution Procedure	LF Tire	LR Tire	RR Tire	RF Tire
Pre-test cold measurements after ambient soak	219.0 kPa	262.1 kPa	265.0 kPa	222.2 kPa

TPMS OPERATIONAL PERFORMANCE
DATA SHEET 3 (Sheet 23 of 64)

GRADUAL DEFLATION TEST 2
Left Rear and Right Front Tire Deflation at LLVW

TIRE INFLATION PRESSURES AND TIRE/SURFACE TEMPERATURES BEFORE CALIBRATION PHASE:

Execution Procedure	LF Tire	LR Tire	RR Tire	RF Tire
After loading vehicle to LLVW, positioning vehicle at selected test start point, and vehicle cool down period: Vehicle cool down period: overnight				
Re-adjusted Inflation Pressure	220.0 kPa	260.0 kPa	260.0 kPa	220.0 kPa
Tire Sidewall Temp	15.4°C	14.8°C	14.8°C	15.4°C
San Angelo Test Facility Shop Floor Temp	16.4°C	16.4°C	16.4°C	16.8°C

SYSTEM CALIBRATION/LEARNING PHASE

Driving in first direction:

Starting point: GAFB South Gate Direction: see chart, page 110
Cumulative vehicle driving time (10 – 15 minutes) at a vehicle speed of 75+ 25 km/h excluding time periods when brake pedal is applied.

11:42 minutes 11.9 distance (mi)

Driving in opposite direction:

Starting point: US Hwy 87 crossover overpass Direction: see chart, page 110
Cumulative vehicle driving time (5 - 12 minutes) at a vehicle speed of 75+ 25 km/h excluding time periods when brake pedal is applied.

8.59 minutes 9.1 distance (mi)

Total stopwatch cumulative driving time (20 - 22 minutes) 20:41 minutes

Max speed: 93.37 km/h

Total Cumulative Driving Time (VBOX processed data): 20:41 minutes
(20 - 22 minutes)

TIRE INFLATION PRESSURES AND TEMPERATURES AFTER CALIBRATION PHASE:

Execution Procedure	LF Tire	LR Tire	RR Tire	RF Tire
Immediately, after vehicle is stopped, engine off: Inflation Pressure	238.6 kPa	278.6 kPa	281.3 kPa	239.6 kPa
Tire Sidewall Temp	27.4°C	24.0°C	26.6°C	32.2°C
Roadway Temp	13.4°C	13.4°C	15.2°C	14.0°C

TPMS OPERATIONAL PERFORMANCE
DATA SHEET 3 (Sheet 24 of 64)

GRADUAL DEFLATION TEST 2
Left Rear and Right Front Tire Deflation at LLVW

TIRE PRESSURE & TEMPERATURE DURING LOW INFLATION PRESSURE TEST

Location of Deflated Tire(s)	**( ) LF**	**(X) LR**	**( ) RR**	**(X) RF**
Original Tire Pressures (kPa)		**260.0 kPa**		**220.0 kPa**

Execution Procedure and Item	**LF Tire**	**LR Tire**	**RR Tire**	**RF Tire**
First 14-kPa Deflation Increment		246.0 kPa		206.0 kPa
Driving in first direction:				
Cumulative driving time (10 - 15 minutes) 11:42 minutes				
Did low inflation pressure telltale illuminate? Yes ___ No X				
Driving in opposite direction:				
Cumulative driving time (5 - 12 minutes) 8:59 minutes				
Did low inflation pressure telltale illuminate? Yes ___ No X				
Total cumulative driving time (20 - 22 minutes) 20:41 minutes				
Tire Pressures and Temperatures	**LF Tire**	**LR Tire**	**RR Tire**	**RF Tire**
Inflation Pressure	239.4 kPa	249.6 kPa	282.3 kPa	210.6 kPa
Temperature	28.0°C	25.2°C	26.2°C	31.0°C

GRADUAL DEFLATION TEST 2
Left Rear and Right Front Tire Deflation at LLVW

TIRE PRESSURE & TEMPERATURE DURING LOW INFLATION PRESSURE TEST

Execution Procedure and Item	LF Tire	LR Tire	RR Tire	RF Tire
Second 14-kPa Deflation Increment		232.0 kPa		192.0 kPa
Driving in first direction:				
Cumulative driving time (10 - 15 minutes)	11:42 minutes			
Did low inflation pressure telltale illuminate?		Yes ___	No X	
Driving in opposite direction:				
Cumulative driving time (5 - 12 minutes)	8:59 minutes			
Did low inflation pressure telltale illuminate?		Yes ___	No X	
Total cumulative driving time (20 - 22 minutes)	20:41 minutes			
Tire Pressures and Temperatures	**LF Tire**	**LR Tire**	**RR Tire**	**RF Tire**
Inflation Pressure	239.3 kPa	234.8 kPa	282.6 kPa	194.7 kPa
Temperature	29.4°C	26.0°C	27.2°C	33.6°C

GRADUAL DEFLATION TEST 2
Left Rear and Right Front Tire Deflation at LLVW

TIRE PRESSURE & TEMPERATURE DURING LOW INFLATION PRESSURE TEST

Execution Procedure and Item	LF Tire	LR Tire	RR Tire	RF Tire
Third 14-kPa Deflation Increment		218.0 kPa		178.0 kPa
Driving in first direction:				
Cumulative driving time (10 - 15 minutes)	11:42 minutes			
Did low inflation pressure telltale illuminate?	Yes ____	No X		
Driving in opposite direction:				
Cumulative driving time (5 - 12 minutes)	8:59 minutes			
Did low inflation pressure telltale illuminate?	Yes ____	No X		
Total cumulative driving time (20 - 22 minutes)	20:41 minutes			
Tire Pressures and Temperatures	**LF Tire**	**LR Tire**	**RR Tire**	**RF Tire**
Inflation Pressure	241.5 kPa	222.5 kPa	284.8 kPa	182.6 kPa
Temperature	30.4°C	27.8°C	29.6°C	35.8°C

TPMS OPERATIONAL PERFORMANCE
DATA SHEET 3 (Sheet 27 of 64)

GRADUAL DEFLATION TEST 2
Left Rear and Right Front Tire Deflation at LLVW

TIRE PRESSURE & TEMPERATURE DURING LOW INFLATION PRESSURE TEST

Execution Procedure and Item	LF Tire	LR Tire	RR Tire	RF Tire
Fourth 14-kPa Deflation Increment		204.0 kPa		164.0 kPa

Driving in first direction:

Non-cumulative driving time (10-15 minutes) 0:44 seconds

Did low inflation pressure telltale illuminate? Yes X No ____

Driving in opposite direction:

Cumulative driving time (5 - 12 minutes) ____ minutes

Did low inflation pressure telltale illuminate? Yes ____ No ____

Total non-cumulative driving time (20-22 minutes) 0:44 seconds

Tire Pressures and Temperatures	LF Tire	LR Tire	RR Tire	RF Tire
Inflation Pressure	241.5 kPa	204.0 kPa	284.8 kPa	164.0 kPa
Temperature	30.4°C	27.8°C	29.6°C	35.8°C

Max speed: N/A km/h

Total Cumulative Driving Time (VBOX processed data): N/A minutes
(20 - 22 minutes)

TPMS OPERATIONAL PERFORMANCE
DATA SHEET 3 (Sheet 28 of 64)

GRADUAL DEFLATION TEST 2
Left Rear and Right Front Tire Deflation at LLVW

TELLTALE ILLUMINATION:

Execution Procedure Paragraph and Item
Did the low inflation pressure warning telltale illuminate before the inflation pressures in the deflated tire(s) reached the low inflation pressure(s) threshold calculated? **__X__ YES (pass) _____ NO**

Does the vehicle identify which tire(s) is (are) under-inflated?
( )YES (X)NO If yes: ( ) Telltale ( ) Reconfigurable Display

Tire Locations Verified: ( )LF ( )LR ( )RR ( )RF

After 5 minutes with the ignition locking system in the “Off” or “Lock” position, does the telltale re-illuminate and stay illuminated when the ignition locking system is activated to the “On” or “Run” position? ( )YES (X)NO

After ignition locking system deactivation the and vehicle engine re-start, does the telltale re-illuminate and stay illuminated when the ignition locking system is activated to the “On” or “Run” position (i.e. Key-on-Engine-on)?
(X)YES ( )NO (fail)

TIRE INFLATION PRESSURES AND TEMPERATURES AFTER TELLTALE ILLUMINATION:

Execution Procedure Paragraph and Item	**LF Tire**	**LR Tire**	**RR Tire**	**RF Tire**
After vehicle cool down period. Vehicle cool down period: 79 minutes				
Inflation Pressure	228.8 kPa	193.6 kPa	267.7 kPa	154.3 kPa
Tire Sidewall Temp	25.2°C	22.0°C	21.8°C	25.0°C
Roadway Temp	19.4°C	19.0°C	18.8°C	19.4°C

TPMS OPERATIONAL PERFORMANCE
DATA SHEET 3 (Sheet 29 of 64)

GRADUAL DEFLATION TEST 2
Left Rear and Right Front Tire Deflation at LLVW

After the cool down period of approximately one hour, and vehicle engine restart, does the telltale re-illuminate and stay illuminated when the ignition locking system is activated to the "On" or "Run" position?

(X)YES ( )NO

TELLTALE EXTINGUISHMENT:

RE-ADJUSTED TIRE INFLATION PRESSURES:

Execution Procedure Paragraph and Item	LF Tire	LR Tire	RR Tire	RF Tire
After cool down period; Re-adjusted Inflation Pressure kPa	220.0 kPa	260.0 kPa	260.0 kPa	220.0 kPa

If vehicle is equipped with a manual reset control, does activation of this control extinguish the telltale?

( )YES ( )NO (X)N/A

Is it necessary to drive the vehicle to extinguish the telltale? (X)YES ( )NO

Starting point: San Angelo Test Facility shop

Total distance to extinguishment: 0.1 mi

Time to extinguishment: 1:21 minutes (non-cumulative stopwatch time)

TPMS PERFORMANCE TEST RESULTS (PASS/FAIL) **PASS**

REMARKS: An alternative route was used due to north gate closure by GAFB

RECORDED BY: Anthony Walden & Tommy Oliver DATE: February 3, 2020

APPROVED BY: Jayton Lindley

TPMS OPERATIONAL PERFORMANCE
DATA SHEET 3 (Sheet 30 of 64)

GRADUAL DEFLATION TEST 3
Left Front, Left Rear, and Right Rear Tire Deflation at LLVW

TEST DATE: February 24, 2020 LAB: U.S. DOT San Angelo Test Facility

VEHICLE NHTSA NUMBER: C20204100

Time:	Start:	8:46 am	End:	1:15 pm
Ambient Temperature:	Start:	11.5°C	End:	19.6°C
Odometer Reading (mi):	Start:	611.2	End:	696.9
Fuel Level:	Start:	Full	End:	3.0 gallons used

Note: See Data Sheet 3 (Sheet 2 of 64) for Test Weight.

Determining FMVSS No. 138 Gradual Deflation Telltale Minimum Warning Activation Pressure for Tires Installed on Vehicle		
Part	**Front Axle**	**Rear Axle**
Recommended Inflation Pressure x .67	220 kPa x .67 = 147.4 kPa	260 kPa x .67 = 174.2 kPa

TIRE INFLATION PRESSURES

Execution Procedure	LF Tire	LR Tire	RR Tire	RF Tire
Pre-test cold measurements after ambient soak	214.6 kPa	254.3 kPa	255.1 kPa	215.0 kPa

TPMS OPERATIONAL PERFORMANCE
DATA SHEET 3 (Sheet 31 of 64)

GRADUAL DEFLATION TEST 3
Left Front, Left Rear, and Right Rear Tire Deflation at LLVW

TIRE INFLATION PRESSURES AND TIRE/SURFACE TEMPERATURES BEFORE CALIBRATION PHASE:

Execution Procedure	LF Tire	LR Tire	RR Tire	RF Tire
After loading vehicle to LLVW, positioning vehicle at selected test start point, and vehicle cool down period: Vehicle cool down period: overnight				
Re-adjusted Inflation Pressure	220.0 kPa	260.0 kPa	260.0 kPa	220.0 kPa
Tire Sidewall Temp	12.4°C	11.8°C	12.4°C	13.2°C
San Angelo Test Facility Shop Floor Temp	14.8°C	14.2°C	14.6°C	15.4°C

SYSTEM CALIBRATION/LEARNING PHASE

Driving in first direction:

Starting point: GAFB South Gate Direction: see chart, page 111
Cumulative vehicle driving time (10 – 15 minutes) at a vehicle speed of 75+ 25 km/h excluding time periods when brake pedal is applied.

11:42 minutes 11.8 distance (mi)

Driving in opposite direction:

Starting point: US Hwy 87 crossover overpass Direction: see chart, page 111
Cumulative vehicle driving time (5 - 12 minutes) at a vehicle speed of 75+ 25 km/h excluding time periods when brake pedal is applied.

8.59 minutes 9.0 distance (mi)

Total stopwatch cumulative driving time (20 - 22 minutes) 20:41 minutes

Max speed: 94.94 km/h

Total Cumulative Driving Time (VBOX processed data): 20:40 minutes
(20 - 22 minutes)

TIRE INFLATION PRESSURES AND TEMPERATURES AFTER CALIBRATION PHASE:

Execution Procedure	LF Tire	LR Tire	RR Tire	RF Tire
Immediately, after vehicle is stopped, engine off: Inflation Pressure	236.1 kPa	276.8 kPa	277.9 kPa	236.2 kPa
Tire Sidewall Temp	23.4°C	20.4°C	22.6°C	27.2°C
Roadway Temp	8.0°C	7.6°C	10.2°C	8.6°C

TPMS OPERATIONAL PERFORMANCE
DATA SHEET 3 (Sheet 32 of 64)

GRADUAL DEFLATION TEST 3
Left Front, Left Rear, and Right Rear Tire Deflation at LLVW

TIRE PRESSURE & TEMPERATURE DURING LOW INFLATION PRESSURE TEST

Location of Deflated Tire(s)	**(X) LF**	**(X) LR**	**(X) RR**	**( ) RF**
Original Tire Pressures (kPa)	**220.0 kPa**	**260.0 kPa**	**260.0 kPa**	

Execution Procedure and Item	**LF Tire**	**LR Tire**	**RR Tire**	**RF Tire**
First 14-kPa Deflation Increment	206.0 kPa	246.0 kPa	246.0 kPa	
Driving in first direction:				
Cumulative driving time (10 - 15 minutes)	11:42 minutes			
Did low inflation pressure telltale illuminate?	Yes ___ No X			
Driving in opposite direction:				
Cumulative driving time (5 - 12 minutes)	8:54 minutes			
Did low inflation pressure telltale illuminate?	Yes ___ No X			
Total cumulative driving time (20 - 22 minutes)	20:36 minutes			
Tire Pressures and Temperatures	**LF Tire**	**LR Tire**	**RR Tire**	**RF Tire**
Inflation Pressure	211.4 kPa	252.4 kPa	251.9 kPa	237.9 kPa
Temperature	31.2°C	28.4°C	23.8°C	28.4°C

GRADUAL DEFLATION TEST 3
Left Front, Left Rear, and Right Rear Tire Deflation at LLVW

TIRE PRESSURE & TEMPERATURE DURING LOW INFLATION PRESSURE TEST

Execution Procedure and Item	LF Tire	LR Tire	RR Tire	RF Tire
Second 14-kPa Deflation Increment	192.0 kPa	232.0 kPa	232.0 kPa	
Driving in first direction:				
Cumulative driving time (10 - 15 minutes)	11:42 minutes			
Did low inflation pressure telltale illuminate?		Yes ____	No X	
Driving in opposite direction:				
Cumulative driving time (5 - 12 minutes)	8:59 minutes			
Did low inflation pressure telltale illuminate?		Yes ____	No X	
Total cumulative driving time (20 - 22 minutes)	20:41 minutes			
Tire Pressures and Temperatures	**LF Tire**	**LR Tire**	**RR Tire**	**RF Tire**
Inflation Pressure	196.9 kPa	236.4 kPa	236.2 kPa	239.6 kPa
Temperature	32.6°C	30.8°C	25.4°C	29.2°C

TPMS OPERATIONAL PERFORMANCE
DATA SHEET 3 (Sheet 34 of 64)

GRADUAL DEFLATION TEST 3
Left Front, Left Rear, and Right Rear Tire Deflation at LLVW

TIRE PRESSURE & TEMPERATURE DURING LOW INFLATION PRESSURE TEST

Execution Procedure and Item	LF Tire	LR Tire	RR Tire	RF Tire
Third 14-kPa Deflation Increment	178.0 kPa	218.0 kPa	218.0 kPa	
Driving in first direction:				
Cumulative driving time (10 - 15 minutes)	11:42 minutes			
Did low inflation pressure telltale illuminate?	Yes ____ No X			
Driving in opposite direction:				
Cumulative driving time (5 - 12 minutes)	8:59 minutes			
Did low inflation pressure telltale illuminate?	Yes ____ No X			
Total cumulative driving time (20 - 22 minutes)	20:41 minutes			
Tire Pressures and Temperatures	**LF Tire**	**LR Tire**	**RR Tire**	**RF Tire**
Inflation Pressure	181.3 kPa	222.1 kPa	222.2 kPa	240.6 kPa
Temperature	35.4°C	29.6°C	28.2°C	30.4°C

TPMS OPERATIONAL PERFORMANCE
DATA SHEET 3 (Sheet 35 of 64)

GRADUAL DEFLATION TEST 3
Left Front, Left Rear, and Right Rear Tire Deflation at LLVW

TIRE PRESSURE & TEMPERATURE DURING LOW INFLATION PRESSURE TEST

Execution Procedure and Item	LF Tire	LR Tire	RR Tire	RF Tire
Fourth 14-kPa Deflation Increment	164.0 kPa	204.0 kPa	204.0 kPa	

Driving in first direction: Driving Not Necessary

Non-cumulative driving time (10-15 minutes) 0:00 minutes

Did low inflation pressure telltale illuminate? Yes ____ No ____

Driving in opposite direction:

Cumulative driving time (5 - 12 minutes) _____ minutes

Did low inflation pressure telltale illuminate? Yes ____ No ____

Total non-cumulative driving time (20-22 minutes) 0:00 minutes

Tire Pressures and Temperatures	LF Tire	LR Tire	RR Tire	RF Tire
Inflation Pressure	164.0 kPa	204.0 kPa	204.0 kPa	240.6 kPa
Temperature	35.4°C	29.6°C	28.2°C	30.4°C

Max speed: N/A km/h

Total Cumulative Driving Time (VBOX processed data): N/A minutes
(20 - 22 minutes)

TPMS OPERATIONAL PERFORMANCE
DATA SHEET 3 (Sheet 36 of 64)

GRADUAL DEFLATION TEST 3
Left Front, Left Rear, and Right Rear Tire Deflation at LLVW

TELLTALE ILLUMINATION:

Execution Procedure Paragraph and Item
Did the low inflation pressure warning telltale illuminate before the inflation pressures in the deflated tire(s) reached the low inflation pressure(s) threshold calculated? **__X__ YES (pass) _____ NO**

Does the vehicle identify which tire(s) is (are) under-inflated?
( )YES (X)NO If yes: ( ) Telltale ( ) Reconfigurable Display

Tire Locations Verified: ( )LF ( )LR ( )RR ( )RF

After 5 minutes with the ignition locking system in the “Off” or “Lock” position, does the telltale re-illuminate and stay illuminated when the ignition locking system is activated to the “On” or “Run” position? ( )YES (X)NO

After ignition locking system deactivation the and vehicle engine re-start, does the telltale re-illuminate and stay illuminated when the ignition locking system is activated to the “On” or “Run” position (i.e. Key-on-Engine-on)?
(X)YES ( )NO (fail)

TIRE INFLATION PRESSURES AND TEMPERATURES AFTER TELLTALE ILLUMINATION:

Execution Procedure Paragraph and Item	**LF Tire**	**LR Tire**	**RR Tire**	**RF Tire**
After vehicle cool down period. Vehicle cool down period: 65 minutes				
Inflation Pressure	154.9 kPa	193.6 kPa	194.0 kPa	228.8 kPa
Tire Sidewall Temp	23.8°C	21.2°C	22.2°C	23.2°C
Roadway Temp	18.0°C	17.6°C	17.6°C	17.8°C

TPMS OPERATIONAL PERFORMANCE
DATA SHEET 3 (Sheet 37 of 64)

GRADUAL DEFLATION TEST 3
Left Front, Left Rear, and Right Rear Tire Deflation at LLVW

After the cool down period of approximately one hour, and vehicle engine restart, does the telltale re-illuminate and stay illuminated when the ignition locking system is activated to the "On" or "Run" position?

(X)YES ( )NO

TELLTALE EXTINGUISHMENT:

RE-ADJUSTED TIRE INFLATION PRESSURES:

Execution Procedure Paragraph and Item	**LF Tire**	**LR Tire**	**RR Tire**	**RF Tire**
After cool down period; Re-adjusted Inflation Pressure kPa	220.0 kPa	260.0 kPa	260.0 kPa	220.0 kPa

If vehicle is equipped with a manual reset control, does activation of this control extinguish the telltale? ( )YES ( )NO (X)N/A

Is it necessary to drive the vehicle to extinguish the telltale? (X)YES ( )NO

Starting point: San Angelo Test Facility shop

Total distance to extinguishment: 0.1 mi

Time to extinguishment: 1:22 minutes (non-cumulative stopwatch time)

TPMS PERFORMANCE TEST RESULTS (PASS/FAIL) **PASS**

REMARKS: An alternative route was used due to north gate closure by GAFB

RECORDED BY: Anthony Walden & Tommy Oliver DATE: February 24, 2020

APPROVED BY: Jayton Lindley

TPMS OPERATIONAL PERFORMANCE
DATA SHEET 3 (Sheet 38 of 64)

TEST DATE: February 4, 2019 LAB: U.S. DOT San Angelo Test Facility

VEHICLE NHTSA NUMBER: C20204100

Time: Start: 8:45 am End: 11:30 am

Ambient Temperature: Start: 19.1°C End: 21.1°C

Trip Odometer Reading: Start: 337.4 mi

Fuel Level: Start: Full

Weather Conditions: Indoors

Time vehicle remained with engine off and tires shielded from direct sunlight (1-hour minimum): overnight

PRE-TEST TIRE INFLATION PRESSURES AND TIRE/SURFACE TEMPERATURES:

Execution Procedure	LF Tire	LR Tire	RR Tire	RF Tire
Pre-test cold measurements after ambient soak: Inflation Pressure	220.0 kPa	260.0 kPa	260.0 kPa	220.0 kPa
Tire Sidewall Temp	17.8°C	17.2°C	17.4°C	17.8°C

TPMS OPERATIONAL PERFORMANCE
DATA SHEET 3 (Sheet 39 of 64)

VEHICLE WEIGHT:

Vehicle Ratings from Certification Label:

GVWR: 2,080 kg, 4,586 lbs.

GAWR (front): 995 kg, 2,194 lbs.

GAWR (rear): 1,160 kg, 2,557 lbs.

Vehicle Capacity Weight from Vehicle Placard:

Vehicle Capacity Weight 375 kg, 827 lbs.

Measured Unloaded Vehicle Weight:

LF	406.0 kg	LR	387.0 kg
RF	410.5 kg	RR	391.5 kg
Front Axle	816.5 kg	Rear Axle	778.5 kg

Total Vehicle 1,595.0 kg

Measured Test Weight: ( ) LLVW (+50, -0 kg) **(X) UVW+VCW** ( ) GVWR (+0, -50 kg)

LF	462.5 kg	LR	521.0 kg
RF	466.5 kg	RR	520.0 kg
Front Axle	929.0 kg (≤ GAWR)	Rear Axle	1,041.0 kg (≤ GAWR)

Total Vehicle 1,970.0 kg (not greater than GVWR)

Note: For Scenarios D and E, Malfunction 2, and Gradual Deflations 4, and 5. This Total Vehicle Weight measures the vehicle loaded to Unloaded Vehicle Weight (UVW) and Vehicle Capacity Weight (VCW). This consisted of the UVW and 375.0 kg of driver, passenger, test equipment, and ballast.

RECORDED BY: Anthony Walden & Tommy Oliver DATE: February 4, 2020

APPROVED BY: Jayton Lindley

TPMS OPERATIONAL PERFORMANCE
DATA SHEET 3 (Sheet 40 of 64)

NORMAL DEFLATION TEST, SCENARIO D
Left Front and Right Front Tire Deflation at UVW+VCW

TEST DATE: February 4, 2020 LAB: U.S. DOT San Angelo Test Facility

VEHICLE NHTSA NUMBER: C20204100

Note: See Data Sheet 3 (Sheet 39 of 64) for Test Weight.

TIRE INFLATION PRESSURES AND TIRE/SURFACE TEMPERATURES BEFORE CALIBRATION PHASE:

Execution Procedure	LF Tire	LR Tire	RR Tire	RF Tire
After loading vehicle to LLVW, positioning vehicle at selected test start point, and vehicle cool down period: Ambient Temperature: 9.1°C Vehicle cool down period: overnight				
Inflation Pressure	220.0 kPa	260.0 kPa	260.0 kPa	220.0 kPa
Tire Sidewall Temp	13.2°C	11.4°C	10.6°C	13.0°C
San Angelo Test Facility Shop Floor Temp	16.0°C	15.2°C	15.0°C	15.6°C

SYSTEM CALIBRATION/LEARNING PHASE:

Time:	Start:	17:35:48 UTC	End:	18:02:27 UTC
Trip Odometer Reading:	Start:	338.6 mi	End:	359.5 mi
Ambient Temperature:	Start:	9.1°C	End:	7.2°C
Roadway Temperature:	Start:	11.4°C	End:	7.2°C
Weather Conditions:		Cold & cloudy		

Driving in first direction:

Starting point: GAFB South Gate Direction: see chart, page 103

11:42 minutes (cumulative stopwatch time) 11.9 mi distance

Driving in opposite direction:

Starting point: US Hwy 87 crossover overpass Direction: see chart, page 103

8:59 minutes (cumulative stopwatch time) 9.0 mi distance

Max speed: 95.15 km/h

Total Cumulative Driving Time: 20:38 minutes (VBOX processed data)

TPMS OPERATIONAL PERFORMANCE
DATA SHEET 3 (Sheet 41 of 64)

NORMAL DEFLATION TEST, SCENARIO D
Left Front and Right Front Tire Deflation at UVW+VCW

TIRE INFLATION PRESSURES AND TEMPERATURES AFTER CALIBRATION PHASE:

Execution Procedure	LF Tire	LR Tire	RR Tire	RF Tire
Immediately, after vehicle is stopped, engine off: Inflation Pressure	231.9 kPa	274.1 kPa	273.3 kPa	228.9 kPa
Tire Sidewall Temp	16.6°C	13.4°C	12.4°C	14.0°C
San Angelo Test Facility Shop Floor Temp	6.6°C	6.4°C	6.8°C	7.2°C

SYSTEM DETECTION PHASE:

LOCATION AND PRESSURE(S) OF DEFLATED TIRE(S):

Execution Procedure	LF Tire	LR Tire	RR Tire	RF Tire
Indicate Location of Tire(s) Deflated: (X)LF ( )LR ( )RR (X)RF Inflation Pressure	158.0 kPa			158.0 kPa

TELLTALE ILLUMINATION:

Starting point: GAFB South Gate Direction: see chart, page 104

Total distance to Illumination: 0.2 mi

Time to illumination: 0:10 seconds (cumulative stopwatch time)

Max Speed: 72.09 km/h

Total Cumulative Driving Time: 0:09 seconds (VBox processed data)

Does the vehicle identify which tire(s) is (are) under-inflated?

( )YES (X)NO If yes: ( ) Telltale ( ) Reconfigurable Display

TELLTALE ILLUMINATES WITHIN 20 MINUTES: (X)YES ( )NO (fail)

After 5 minutes with the ignition locking system in the “Off” or “Lock” position, does the telltale re-illuminate and stay illuminated when the ignition locking system is activated to the “On” or “Run” position? ( )YES (X)NO

Deactivate the ignition locking system and then re-start the vehicle engine. Does the telltale re-illuminate and stay illuminated when the ignition locking system is activated to the “On” or “Run” position? (X)YES ( )NO (fail)

TPMS OPERATIONAL PERFORMANCE
DATA SHEET 3 (Sheet 42 of 64)

NORMAL DEFLATION TEST, SCENARIO D
Left Front and Right Front Tire Deflation at UVW+VCW

TIRE INFLATION PRESSURES AND TEMPERATURES AFTER TELLTALE ILLUMINATION:

Execution Procedure	LF Tire	LR Tire	RR Tire	RF Tire
After vehicle cool down period: Ambient Temperature: 11.6°C Vehicle cool down period: 68 minutes				
Inflation Pressure	153.3 kPa	261.0 kPa	259.6 kPa	154.4 kPa
Tire Sidewall Temp	16.4°C	12.8°C	10.8°C	13.8°C
San Angelo Test Facility Shop Floor Temp	15.4°C	14.2°C	14.0°C	14.0°C

After the cool down period of a minimum of one hour, does the telltale re-illuminate and stay illuminated when the ignition locking system is activated to the “On” or “Run” position?

(X)YES ( )NO (fail)

TELLTALE EXTINGUISHMENT:

RE-ADJUSTED TIRE INFLATION PRESSURES:

Execution Procedure	LF Tire	LR Tire	RR Tire	RF Tire
After illumination verification: Re-adjusted Inflation Pressure:	220.0 kPa	260.0 kPa	260.0 kPa	220.0 kPa

Is it necessary to use the set/reset button to extinguish the low tire pressure telltale?

( )YES ( )NO (X)N/A

Is it necessary to drive the vehicle to extinguish the telltale? (X)YES ( )NO

Starting point: San Angelo Test Facility

Total distance to extinguishment: 0.1 mi

Time to extinguishment: 0:49 seconds (non-cumulative stopwatch time)

TEST RESULTS

TPMS Performance Test Results (PASS/FAIL) **PASS**
Left front and right front tires were deflated at UVW+VCW

REMARKS: An alternative route was used due to north gate closure by GAFB

RECORDED BY: Anthony Walden & Tommy Oliver DATE: February 4, 2020

APPROVED BY: Jayton Lindley

TPMS OPERATIONAL PERFORMANCE
DATA SHEET 3 (Sheet 43 of 64)

NORMAL DEFLATION TEST, SCENARIO E
Left Rear, Right Rear, and Right Front Tires Deflation at UVW+VCW

TEST DATE: February 7, 2020 LAB: U.S. DOT San Angelo Test Facility

VEHICLE NHTSA NUMBER: C20204100

Note: See Data Sheet 3 (Sheet 39 of 64) for Test Weight.

TIRE INFLATION PRESSURES AND TIRE/SURFACE TEMPERATURES BEFORE CALIBRATION PHASE:

Execution Procedure	LF Tire	LR Tire	RR Tire	RF Tire
After loading vehicle to UVW+VCW, positioning vehicle at selected test start point, and vehicle cool down period: Ambient Temperature: 10.8°C Vehicle cool down period: overnight				
Inflation Pressure	220.0 kPa	260.0 kPa	260.0 kPa	220.0 kPa
Tire Sidewall Temp	11.4°C	11.4°C	11.4°C	12.4°C
San Angelo Test Facility Shop Floor Temp	15.8°C	15.4°C	15.4°C	16.2°C

SYSTEM CALIBRATION/LEARNING PHASE:

Time: Start: 15:29:55 UTC End: 15:57:25 UTC

Trip Odometer Reading: Start: 363.3 mi End: 384.2 mi

Ambient Temperature: Start: 10.8°C End: 12.6°C

Roadway Temperature: Start: 6.6°C End: 5.4°C

Weather Conditions: Cold and clear

Driving in first direction:

Starting point: GAFB South Gate Direction: see chart, page 105

11:42 minutes (cumulative stopwatch time) 11.9 mi distance

Driving in opposite direction:

Starting point: US Hwy 87 crossover overpass Direction: see chart, page 105

8:59 minutes (cumulative stopwatch time) 9.0 mi distance

Max speed: 94.94 km/h

Total Cumulative Driving Time: 20:40 minutes (VBOX processed data)

TPMS OPERATIONAL PERFORMANCE
DATA SHEET 3 (Sheet 44 of 64)

NORMAL DEFLATION TEST, SCENARIO E
Left Rear, Right Rear, and Right Front Tires Deflation at UVW+VCW

TIRE INFLATION PRESSURES AND TEMPERATURES AFTER CALIBRATION PHASE:

Execution Procedure	LF Tire	LR Tire	RR Tire	RF Tire
Immediately, after vehicle is stopped, engine off: Inflation Pressure	236.9 kPa	278.6 kPa	278.3 kPa	234.2 kPa
Tire Sidewall Temp	24.2°C	24.6°C	15.8°C	18.0°C
San Angelo Test Facility Shop Floor Temp	5.4°C	4.2°C	3.2°C	3.6°C

SYSTEM DETECTION PHASE:

LOCATION AND PRESSURE(S) OF DEFLATED TIRE(S):

Execution Procedure	LF Tire	LR Tire	RR Tire	RF Tire
Indicate Location of Tire(s) Deflated: ( )LF (X)LR (X)RR (X)RF				
Inflation Pressure		188.0 kPa	188.0 kPa	158.0 kPa

TELLTALE ILLUMINATION:

Starting point: GAFB South Gate Direction: see chart, page 106

Total distance to Illumination: 0.2 mi

Time to illumination: 0:06 seconds (cumulative stopwatch time)

Max Speed: 68.60 km/h

Total Cumulative Driving Time: 0:07 seconds (VBox processed data)

Does the vehicle identify which tire(s) is (are) under-inflated?

( )YES (X)NO If yes: ( ) Telltale ( ) Reconfigurable Display

TELLTALE ILLUMINATES WITHIN 20 MINUTES: (X)YES ( )NO (fail)

After 5 minutes with the ignition locking system in the “Off” or “Lock” position, does the telltale re-illuminate and stay illuminated when the ignition locking system is activated to the “On” or “Run” position? ( )YES (X)NO

Deactivate the ignition locking system and then re-start the vehicle engine. Does the telltale re-illuminate and stay illuminated when the ignition locking system is activated to the “On” or “Run” position? (X)YES ( )NO (fail)

TPMS OPERATIONAL PERFORMANCE
DATA SHEET 3 (Sheet 45 of 64)

NORMAL DEFLATION TEST, SCENARIO E
Left Rear, Right Rear, and Right Front Tires Deflation at UVW+VCW

TIRE INFLATION PRESSURES AND TEMPERATURES AFTER TELLTALE ILLUMINATION:

Execution Procedure	LF Tire	LR Tire	RR Tire	RF Tire
After vehicle cool down period: Ambient Temperature: 15.3°C Vehicle cool down period: 65 minutes				
Inflation Pressure	228.4 kPa	181.3 kPa	182.4 kPa	156.5 kPa
Tire Sidewall Temp	19.8°C	17.8°C	17.2°C	19.4°C
San Angelo Test Facility Shop Floor Temp	17.6°C	17.0°C	16.6°C	17.2°C

After the cool down period of a minimum of one hour, does the telltale re-illuminate and stay illuminated when the ignition locking system is activated to the "On" or "Run" position?
(X)YES ( )NO (fail)

TELLTALE EXTINGUISHMENT:

RE-ADJUSTED TIRE INFLATION PRESSURES:

Execution Procedure	LF Tire	LR Tire	RR Tire	RF Tire
After illumination verification: Re-adjusted Inflation Pressure:	220.0 kPa	260.0 kPa	260.0 kPa	220.0 kPa

Is it necessary to use the set/reset button to extinguish the low tire pressure telltale?
( )YES ( )NO (X)N/A

Is it necessary to drive the vehicle to extinguish the telltale? ( )YES (X)NO

Starting point: Driving Not Necessary

Total distance to extinguishment: N/A

Time to extinguishment: N/A minutes (non-cumulative stopwatch time)

TEST RESULTS

TPMS Performance Test Results (PASS/FAIL) **PASS**
Left rear, right rear, and right front were deflated at UVW+VCW.

REMARKS: An alternative route was used due to north gate closure by GAFB

RECORDED BY: Anthony Walden & Tommy Oliver DATE: February 7, 2020

APPROVED BY: Jayton Lindley

TPMS OPERATIONAL PERFORMANCE
DATA SHEET 3 (Sheet 46 of 64)

MALFUNCTION DETECTION TEST 2
Disconnected FBD4 Module (RF Receiver for TPMS Sensors) at UVW+VCW

TEST DATE: February 19, 2020 LAB: U.S. DOT San Angelo Test Facility

VEHICLE NHTSA NUMBER: C20204100

Time:	Start:	9:30 am	End:	10:35 am
Trip Odometer Reading:	Start:	608.6 mi	End:	610.8 mi
Ambient Temperature:	Start:	10.8°C	End:	11.2°C

Note: See Data Sheet 3 (Sheet 39 of 64) for Test Weight.

TPMS TYPE: (X) Direct ( ) Indirect ( ) Other Describe: _____

TPMS MALFUNCTION TELLTALE:
( ) Dedicated stand-alone (X) Combination low tire pressure warning/malfunction telltale

METHOD OF MALFUNCTION SIMULATION:

Describe method of malfunction simulation: TPMS Right Front sensor disconnected (FBD4 module) (see remarks) (See Figure 5.15)

MALFUNCTION TELLTALE ILLUMINATION
(after ignition locking system is activated to "On" ("Run") position):

Combination Malfunction Telltale

Driving in first direction:

TELLTALE ILLUMINATION:

Starting point: San Angelo Test Facility shop

Total distance to illumination: 0.9 mi

Time to illumination: 3:44 minutes total non-cumulative driving time

Max speed: N/A

Total Cumulative Driving Time: N/A minutes (VBOX processed data)

TEST RESULTS

COMBINATION MALFUNCTION TELLTALE ILLUMINATES (FLASHING AND ILLUMINATION SEQUENCE) WITHIN 20 MINUTES: **(X)YES ( )NO**

TPMS OPERATIONAL PERFORMANCE
DATA SHEET 3 (Sheet 47 of 64)

MALFUNCTION DETECTION TEST 2
Disconnected FBD4 Module (RF Receiver for TPMS Sensors) at UVW+VCW

After 5 minutes with the ignition locking system in the "Off" or "Lock" position, does the combination low tire pressure/malfunction telltale flash for a period of at least 60 seconds but no longer than 90 seconds, and then remain illuminated when the ignition locking system is activated to the "On" or "Run" position? (X)YES ( )NO (fail)

Time it takes before telltale starts flashing	4	seconds
Time telltale remains flashing	65	seconds
Time telltale remains illuminated (Verified for a minimum of 60 seconds)	60+	seconds

Deactivate the ignition locking system and then re-start the vehicle engine. Does the telltale's illumination sequence repeat when the ignition locking system is activated and the engine running? (X)YES ( )NO (fail)

Extinguishment Phase:

Starting point: Driving Not Necessary

Total distance to extinguishment: N/A

Time to extinguishment: N/A total driving time (non-cumulative stopwatch time)

COMBINATION MALFUNCTION TELLTALE EXTINGUISHED:
(X)YES ( )NO (FAIL)

TPMS MALFUNCTION PERFORMANCE TEST RESULTS (PASS/FAIL) **PASS**
Disconnected FBD4 Module (RF receiver for TPMS Sensors)

REMARKS: An alternative route was used due to north gate closure by GAFB

RECORDED BY: Anthony Walden & Tommy Oliver DATE: February 19, 2020

APPROVED BY: Jayton Lindley

TPMS OPERATIONAL PERFORMANCE
DATA SHEET 3 (Sheet 48 of 64)

GRADUAL DEFLATION TEST 4
Right Rear Tire Deflation at UVW+VCW

TEST DATE: February 13, 2020 LAB: U.S. DOT San Angelo Test Facility

VEHICLE NHTSA NUMBER: C20204100

Time:	Start: 10:34 am	End: 2:30 pm
Ambient Temperature	Start: 6.8°C	End: 12.8^{0}C
Odometer Reading (mi):	Start: 386.3	End: 493.0
Fuel Level:	Start: Full	End: 4.4 gallons below full

Note: See Data Sheet 3 (Sheet 39 of 64) for Test Weight.

Determining FMVSS No. 138 Gradual Deflation Telltale Minimum Warning Activation Pressure for Tires Installed on Vehicle		
Part	**Front Axle**	**Rear Axle**
Recommended Inflation Pressure x .67	220 kPa x .67 = 147.4 kPa	260 kPa x .67 = 174.2 kPa

TIRE INFLATION PRESSURES AND TIRE/ROADWAY TEMPERATURES

Execution Procedure	LF Tire	LR Tire	RR Tire	RF Tire
Pre-test cold measurements after ambient soak	222.2 kPa	252.2 kPa	250.8 kPa	212.4 kPa

TPMS OPERATIONAL PERFORMANCE
DATA SHEET 3 (Sheet 49 of 64)

GRADUAL DEFLATION TEST 4
Right Rear Tire Deflation at UVW+VCW

TIRE INFLATION PRESSURES AND TIRE/SURFACE TEMPERATURES BEFORE CALIBRATION PHASE:

Execution Procedure	LF Tire	LR Tire	RR Tire	RF Tire
After loading vehicle to LLVW, positioning vehicle at selected test start point, and vehicle cool down period: Vehicle cool down period: overnight				
Re-adjusted Inflation Pressure	220.0 kPa	260.0 kPa	260.0 kPa	220.0 kPa
Tire Sidewall Temp	10.08C	10.6°C	9.6°C	10.2°C
San Angelo Test Facility Shop Floor Temp	13.8°C	13.4°C	13.8°C	14.2°C

SYSTEM CALIBRATION/LEARNING PHASE

Driving in first direction:

Starting point: GAFB South Gate Direction: see chart, page 112
Cumulative vehicle driving time (10 – 15 minutes) at a vehicle speed of 75± 25 km/h excluding time periods when brake pedal is applied.

11:42 minutes 11.9 distance (mi)

Driving in opposite direction:

Starting point: US Hwy 87 crossover overpass Direction: see chart, page 112
Cumulative vehicle driving time (5 - 12 minutes) at a vehicle speed of 75± 25 km/h excluding time periods when brake pedal is applied.

8:59 minutes 9.0 distance (mi)

Total stopwatch cumulative driving time (20 - 22 minutes) 20:41 minutes

Max speed: 95.29 km/h

Total Cumulative Driving Time (VBOX processed data): 20:41 minutes
(20 - 22 minutes)

TIRE INFLATION PRESSURES AND TEMPERATURES AFTER CALIBRATION PHASE:

Execution Procedure	LF Tire	LR Tire	RR Tire	RF Tire
Immediately, after vehicle is stopped, engine off: Inflation Pressure	233.0 kPa	274.1 kPa	275.2 kPa	231.4 kPa
Tire Sidewall Temp	20.2°C	14.8°C	13.8°C	15.4°C
Roadway Temp	7.2°C	6.4°C	7.4°C	7.2°C

TPMS OPERATIONAL PERFORMANCE
DATA SHEET 3 (Sheet 50 of 64)

GRADUAL DEFLATION TEST 4
Right Rear Tire Deflation at UVW+VCW

TIRE PRESSURE & TEMPERATURE DURING LOW INFLATION PRESSURE TEST

Location of Deflated Tire(s)	**( ) LF**	**( ) LR**	**(X) RR**	**( ) RF**
Original Tire Pressures (kPa)			**260.0 kPa**	

Execution Procedure and Item	**LF Tire**	**LR Tire**	**RR Tire**	**RF Tire**
First 14-kPa Deflation Increment			246.0 kPa	
Driving in first direction:				
Cumulative driving time (10 - 15 minutes) 11:42 minutes				
Did low inflation pressure telltale illuminate? Yes ____ No X				
Driving in opposite direction:				
Cumulative driving time (5 - 12 minutes) 8:59 minutes				
Did low inflation pressure telltale illuminate? Yes ____ No X				
Total cumulative driving time (20 - 22 minutes) 20.41 minutes				
Tire Pressures and Temperatures	**LF Tire**	**LR Tire**	**RR Tire**	**RF Tire**
Inflation Pressure	233.8 kPa	274.6 kPa	250.8 kPa	232.5 kPa
Temperature	20.2°C	14.6°C	13.2°C	15.4°C

TPMS OPERATIONAL PERFORMANCE
DATA SHEET 3 (Sheet 51 of 64)

GRADUAL DEFLATION TEST 4
Right Rear Tire Deflation at UVW+VCW

TIRE PRESSURE & TEMPERATURE DURING LOW INFLATION PRESSURE TEST

Execution Procedure and Item	LF Tire	LR Tire	RR Tire	RF Tire
Second 14-kPa Deflation Increment			232.0 kPa	

Driving in first direction:

Cumulative driving time (10 - 15 minutes) 11:43 minutes

Did low inflation pressure telltale illuminate? Yes ____ No X

Driving in opposite direction:

Cumulative driving time (5 - 12 minutes) 8:58 minutes

Did low inflation pressure telltale illuminate? Yes ____ No X

Total cumulative driving time (20 - 22 minutes) 20:41 minutes

Tire Pressures and Temperatures	LF Tire	LR Tire	RR Tire	RF Tire
Inflation Pressure	233.6 kPa	274.9 kPa	235.0 kPa	232.4 kPa
Temperature	19.6°C	15.0°C	14.8°C	15.4°C

TPMS OPERATIONAL PERFORMANCE
DATA SHEET 3 (Sheet 52 of 64)

GRADUAL DEFLATION TEST 4
Right Rear Tire Deflation at UVW+VCW

TIRE PRESSURE & TEMPERATURE DURING LOW INFLATION PRESSURE TEST

Execution Procedure and Item	LF Tire	LR Tire	RR Tire	RF Tire
Third 14-kPa Deflation Increment			218.0 kPa	

Driving in first direction:

Cumulative driving time (10 - 15 minutes) 11:42 minutes

Did low inflation pressure telltale illuminate? Yes ____ No X

Driving in opposite direction:

Cumulative driving time (5 - 12 minutes) 8:59 minutes

Did low inflation pressure telltale illuminate? Yes ____ No X

Total cumulative driving time (20 - 22 minutes) 20:41 minutes

Tire Pressures and Temperatures	LF Tire	LR Tire	RR Tire	RF Tire
Inflation Pressure	234.0 kPa	274.5 kPa	221.2 kPa	233.0 kPa
Temperature	20.6°C	16.6°C	18.2°C	18.6°C

TPMS OPERATIONAL PERFORMANCE
DATA SHEET 3 (Sheet 53 of 64)

GRADUAL DEFLATION TEST 4
Right Rear Tire Deflation at UVW+VCW

TIRE PRESSURE & TEMPERATURE DURING LOW INFLATION PRESSURE TEST

Execution Procedure and Item	LF Tire	LR Tire	RR Tire	RF Tire
Fourth 14-kPa Deflation Increment			204.0 kPa	

Driving in first direction:

Cumulative driving time (10 - 15 minutes) 11:42 minutes

Did low inflation pressure telltale illuminate? Yes ____ No X

Driving in opposite direction:

Cumulative driving time (5 - 12 minutes) 8:59 minutes

Did low inflation pressure telltale illuminate? Yes ____ No X

Total cumulative driving time (20 - 22 minutes) 20:41 minutes

Tire Pressures and Temperatures	LF Tire	LR Tire	RR Tire	RF Tire
Inflation Pressure	234.8 kPa	275.6 kPa	208.0 kPa	233.9 kPa
Temperature	20.8°C	16.6°C	18.2°C	17.6°C

TPMS OPERATIONAL PERFORMANCE
DATA SHEET 3 (Sheet 54 of 64)

GRADUAL DEFLATION TEST 4
Right Rear Tire Deflation at UVW+VCW

TIRE PRESSURE & TEMPERATURE DURING LOW INFLATION PRESSURE TEST

Execution Procedure and Item	**LF Tire**	**LR Tire**	**RR Tire**	**RF Tire**
Fifth 14-kPa Deflation Increment			190.0 kPa	

Driving in first direction: Driving Not Necessary

Non-cumulative driving time (10-15 minutes) 0:00 minutes

Did low inflation pressure telltale illuminate? Yes ____ No ____

Driving in opposite direction:

Cumulative driving time (5 - 12 minutes) _____ minutes

Did low inflation pressure telltale illuminate? Yes ____ No ____

Total cumulative driving time (20-22 minutes) 0:00 minutes

Tire Pressures and Temperatures	**LF Tire**	**LR Tire**	**RR Tire**	**RF Tire**
Inflation Pressure	234.8 kPa	275.6 kPa	190.0 kPa	233.9 kPa
Temperature	20.8°C	16.6°C	18.2°C	17.6°C

Max speed: N/A km/h

Total Cumulative Driving Time (VBOX processed data): N/A minutes
(20 - 22 minutes)

TPMS OPERATIONAL PERFORMANCE
DATA SHEET 3 (Sheet 55 of 64)

GRADUAL DEFLATION TEST 4
Right Rear Tire Deflation at UVW+VCW

TELLTALE ILLUMINATION:

Execution Procedure Paragraph and Item
Did the low inflation pressure warning telltale illuminate before the inflation pressures in the deflated tire(s) reached the low inflation pressure(s) threshold calculated? **__X__ YES (pass) _____ NO**

Does the vehicle identify which tire(s) is (are) under-inflated?
( )YES (X)NO If yes: ( ) Telltale ( ) Reconfigurable Display

Tire Locations Verified: ( )LF ( )LR ( )RR ( )RF

After 5 minutes with the ignition locking system in the “Off” or “Lock” position, does the telltale re-illuminate and stay illuminated when the ignition locking system is activated to the “On” or “Run” position? ( )YES (X)NO

After ignition locking system deactivation the and vehicle engine re-start, does the telltale re-illuminate and stay illuminated when the ignition locking system is activated to the “On” or “Run” position (i.e. Key-on-Engine-on)?

(X)YES ( )NO (fail)

TIRE INFLATION PRESSURES AND TEMPERATURES AFTER TELLTALE ILLUMINATION:

Execution Procedure Paragraph and Item	**LF Tire**	**LR Tire**	**RR Tire**	**RF Tire**
After vehicle cool down period. Vehicle cool down period: 64 minutes				
Inflation Pressure	223.9 kPa	261.7 kPa	179.1 kPa	224.9 kPa
Tire Sidewall Temp	18.4°C	15.4°C	15.0°C	16.4°C
Roadway Temp	15.0°C	14.8°C	14.8°C	15.4°C

.

TPMS OPERATIONAL PERFORMANCE
DATA SHEET 3 (Sheet 56 of 64)

GRADUAL DEFLATION TEST 4
Right Rear Tire Deflation at UVW+VCW

After the cool down period of approximately one hour, and vehicle engine restart, does the telltale re-illuminate and stay illuminated when the ignition locking system is activated to the "On" or "Run" position?

(X)YES ( )NO

TELLTALE EXTINGUISHMENT:

RE-ADJUSTED TIRE INFLATION PRESSURES:

Execution Procedure Paragraph and Item	LF Tire	LR Tire	RR Tire	RF Tire
After cool down period; Re-adjusted Inflation Pressure kPa	220.0 kPa	260.0 kPa	260.0 kPa	220.0 kPa

If vehicle is equipped with a manual reset control, does activation of this control extinguish the telltale?

( )YES ( )NO (X)N/A

Is it necessary to drive the vehicle to extinguish the telltale? ( )YES (X)NO

Starting point: Driving Not Necessary

Total distance to extinguishment: N/A

Time to extinguishment: N/A minutes (non-cumulative stopwatch time)

TPMS PERFORMANCE TEST RESULTS (PASS/FAIL) **PASS**

Right Rear tire deflation at UVW+VCW

REMARKS: An alternative route was used due to north gate closure by GAFB

RECORDED BY: Anthony Walden & Tommy Oliver DATE: February 13, 2020

APPROVED BY: Jayton Lindley

TPMS OPERATIONAL PERFORMANCE
DATA SHEET 3 (Sheet 57 of 64)

GRADUAL DEFLATION TEST 5
Right Rear and Right Front Tire Deflation at UVW+VCW

TEST DATE: February 18, 2020 LAB: U.S. DOT San Angelo Test Facility

VEHICLE NHTSA NUMBER: C20204100

Time:	Start:	8:35 am	End:	12:17 pm
Ambient Temperature	Start:	12.0°C	End:	13.0°C
Odometer Reading (mi):	Start:	522.4	End:	608.2
Fuel Level:	Start:	Full	End:	1/8th of tank low

Note: See Data Sheet 3 (Sheet 39 of 64) for Test Weight.

Determining FMVSS No. 138 Gradual Deflation Telltale Minimum Warning Activation Pressure for Tires Installed on Vehicle		
Part	**Front Axle**	**Rear Axle**
Recommended Inflation Pressure x .67	220 kPa x .67 = 147.4 kPa	260 kPa x .67 = 174.2 kPa

TIRE INFLATION PRESSURES AND TIRE/ROADWAY TEMPERATURES

Execution Procedure	LF Tire	LR Tire	RR Tire	RF Tire
Pre-test cold measurements after ambient soak	220.6 kPa	259.9 kPa	260.2 kPa	220.8 kPa

TPMS OPERATIONAL PERFORMANCE
DATA SHEET 3 (Sheet 58 of 64)

GRADUAL DEFLATION TEST 5
Right Rear and Right Front Tire Deflation at UVW+VCW

TIRE INFLATION PRESSURES AND TIRE/SURFACE TEMPERATURES BEFORE CALIBRATION PHASE:

Execution Procedure	LF Tire	LR Tire	RR Tire	RF Tire
After loading vehicle to LLVW, positioning vehicle at selected test start point, and vehicle cool down period: Vehicle cool down period: overnight				
Re-adjusted Inflation Pressure	220.0 kPa	260.0 kPa	260.0 kPa	220.0 kPa
Tire Sidewall Temp	14.0°C	14.2°C	12.4°C	13.8°C
San Angelo Test Facility Shop Floor Temp	15.8°C	15.8°C	15.2°C	16.0°C

SYSTEM CALIBRATION/LEARNING PHASE

Driving in first direction:

Starting point: GAFB South Gate Direction: see chart, page 113
Cumulative vehicle driving time (10 – 15 minutes) at a vehicle speed of 75± 25 km/h excluding time periods when brake pedal is applied.

11:42 minutes 12.0 distance (mi)

Driving in opposite direction:

Starting point: US Hwy 87 crossover overpass Direction: see chart, page 113
Cumulative vehicle driving time (5 - 12 minutes) at a vehicle speed of 75± 25 km/h excluding time periods when brake pedal is applied.

8:59 minutes 8.9 distance (mi)

Total stopwatch cumulative driving time (20 - 22 minutes) 20:41 minutes

Max speed: 91.82 km/h

Total Cumulative Driving Time (VBOX processed data): 20:41 minutes
(20 - 22 minutes)

TIRE INFLATION PRESSURES AND TEMPERATURES AFTER CALIBRATION PHASE:

Execution Procedure	LF Tire	LR Tire	RR Tire	RF Tire
Immediately, after vehicle is stopped, engine off: Inflation Pressure	233.9 kPa	274.1 kPa	275.7 kPa	232.2 kPa
Tire Sidewall Temp	21.6°C	16.4°C	16.4°C	17.4°C
Roadway Temp	11.6°C	10.8°C	10.8°C	10.8°C

GRADUAL DEFLATION TEST 5
Right Rear and Right Front Tire Deflation at UVW+VCW

TIRE PRESSURE & TEMPERATURE DURING LOW INFLATION PRESSURE TEST

Location of Deflated Tire(s)	**( ) LF**	**( ) LR**	**(X) RR**	**(X) RF**
Original Tire Pressures (kPa)			**260.0 kPa**	**220.0 kPa**

Execution Procedure and Item	**LF Tire**	**LR Tire**	**RR Tire**	**RF Tire**
First 14-kPa Deflation Increment			246.0 kPa	206.0 kPa
Driving in first direction:				
Cumulative driving time (10 - 15 minutes) 11:42 minutes				
Did low inflation pressure telltale illuminate? Yes ____ No X				
Driving in opposite direction:				
Cumulative driving time (5 - 12 minutes) 8:59 minutes				
Did low inflation pressure telltale illuminate? Yes ____ No X				
Total cumulative driving time (20 - 22 minutes) 20.41 minutes				
Tire Pressures and Temperatures	**LF Tire**	**LR Tire**	**RR Tire**	**RF Tire**
Inflation Pressure	232.6 kPa	273.7 kPa	249.6 kPa	209.4 kPa
Temperature	21.0°C	16.4°C	17.6°C	20.2°C

GRADUAL DEFLATION TEST 5
Right Rear and Right Front Tire Deflation at UVW+VCW

TIRE PRESSURE & TEMPERATURE DURING LOW INFLATION PRESSURE TEST

Execution Procedure and Item	LF Tire	LR Tire	RR Tire	RF Tire
Second 14-kPa Deflation Increment			232.0 kPa	192.0 kPa

Driving in first direction:

Cumulative driving time (10 - 15 minutes) 11:42 minutes

Did low inflation pressure telltale illuminate? Yes ____ No X

Driving in opposite direction:

Cumulative driving time (5 - 12 minutes) 8:59 minutes

Did low inflation pressure telltale illuminate? Yes ____ No X

Total cumulative driving time (20 - 22 minutes) 20:41 minutes

Tire Pressures and Temperatures	LF Tire	LR Tire	RR Tire	RF Tire
Inflation Pressure	231.9 kPa	273.3 kPa	234.5 kPa	194.6 kPa
Temperature	18.8°C	15.8°C	16.6°C	19.0°C

GRADUAL DEFLATION TEST 5
Right Rear and Right Front Tire Deflation at UVW+VCW

TIRE PRESSURE & TEMPERATURE DURING LOW INFLATION PRESSURE TEST

Execution Procedure and Item	LF Tire	LR Tire	RR Tire	RF Tire
Third 14-kPa Deflation Increment			218.0 kPa	178.0 kPa

Driving in first direction:

Cumulative driving time (10 - 15 minutes) 11:42 minutes

Did low inflation pressure telltale illuminate? Yes ____ No X

Driving in opposite direction:

Cumulative driving time (5 - 12 minutes) 8:59 minutes

Did low inflation pressure telltale illuminate? Yes ____ No X

Total cumulative driving time (20 - 22 minutes) 20:41 minutes

Tire Pressures and Temperatures	LF Tire	LR Tire	RR Tire	RF Tire
Inflation Pressure	232.5 kPa	273.7 kPa	222.4 kPa	181.1 kPa
Temperature	21.2°C	17.2°C	19.2°C	21.8°C

TPMS OPERATIONAL PERFORMANCE
DATA SHEET 3 (Sheet 62 of 64)

GRADUAL DEFLATION TEST 5
Right Rear and Right Front Tire Deflation at UVW+VCW

TIRE PRESSURE & TEMPERATURE DURING LOW INFLATION PRESSURE TEST

Execution Procedure and Item	LF Tire	LR Tire	RR Tire	RF Tire
Fourth 14-kPa Deflation Increment			204.0 kPa	164.0 kPa

Driving in first direction: Driving Not Necessary

Non-cumulative driving time (10-15 minutes) 0:00 minutes

Did low inflation pressure telltale illuminate? Yes ____ No ____

Driving in opposite direction:

Cumulative driving time (5 - 12 minutes) _____ minutes

Did low inflation pressure telltale illuminate? Yes ____ No ____

Total cumulative driving time (20-22 minutes) 0:00 minutes

Tire Pressures and Temperatures	LF Tire	LR Tire	RR Tire	RF Tire
Inflation Pressure	232.5 kPa	273.7 kPa	204.0 kPa	164.0 kPa
Temperature	21.2°C	17.2°C	19.2°C	21.8°C

Max speed: N/A km/h

Total Cumulative Driving Time (VBOX processed data): N/A minutes
(20 - 22 minutes)

GRADUAL DEFLATION TEST 5
Right Rear and Right Front Tire Deflation at UVW+VCW

TELLTALE ILLUMINATION:

Execution Procedure Paragraph and Item
Did the low inflation pressure warning telltale illuminate before the inflation pressures in the deflated tire(s) reached the low inflation pressure(s) threshold calculated? **__X__ YES (pass) _____ NO**

Does the vehicle identify which tire(s) is (are) under-inflated?
( )YES (X)NO If yes: ( ) Telltale ( ) Reconfigurable Display

Tire Locations Verified: ( )LF ( )LR ( )RR ( )RF

After 5 minutes with the ignition locking system in the “Off” or “Lock” position, does the telltale re-illuminate and stay illuminated when the ignition locking system is activated to the “On” or “Run” position? ( )YES (X)NO

After ignition locking system deactivation the and vehicle engine re-start, does the telltale re-illuminate and stay illuminated when the ignition locking system is activated to the “On” or “Run” position (i.e. Key-on-Engine-on)?
(X)YES ( )NO (fail)

TIRE INFLATION PRESSURES AND TEMPERATURES AFTER TELLTALE ILLUMINATION:

Execution Procedure Paragraph and Item	**LF Tire**	**LR Tire**	**RR Tire**	**RF Tire**
After vehicle cool down period. Vehicle cool down period: 68 minutes				
Inflation Pressure	221.2 kPa	258.2 kPa	191.4 kPa	156.2 kPa
Tire Sidewall Temp	18.0°C	14.8°C	13.6°C	17.6°C
Roadway Temp	16.4°C	15.4°C	15.4°C	16.4°C

.

TPMS OPERATIONAL PERFORMANCE
DATA SHEET 3 (Sheet 64 of 64)

GRADUAL DEFLATION TEST 5
Right Rear and Right Front Tire Deflation at UVW+VCW

After the cool down period of approximately one hour, and vehicle engine restart, does the telltale re-illuminate and stay illuminated when the ignition locking system is activated to the "On" or "Run" position?

(X)YES ( )NO

TELLTALE EXTINGUISHMENT:

RE-ADJUSTED TIRE INFLATION PRESSURES:

Execution Procedure Paragraph and Item	LF Tire	LR Tire	RR Tire	RF Tire
After cool down period; Re-adjusted Inflation Pressure kPa	220.0 kPa	260.0 kPa	260.0 kPa	220.0 kPa

If vehicle is equipped with a manual reset control, does activation of this control extinguish the telltale?

( )YES ( )NO (X)N/A

Is it necessary to drive the vehicle to extinguish the telltale? ( )YES (X)NO

Starting point: Driving Not Necessary

Total distance to extinguishment: N/A

Time to extinguishment: N/A minutes (non-cumulative stopwatch time)

TPMS PERFORMANCE TEST RESULTS (PASS/FAIL) **PASS**

Right Rear and Right Front tires deflation at UVW+VCW

REMARKS: An alternative route was used due to north gate closure by GAFB

RECORDED BY: Anthony Walden & Tommy Oliver DATE: February 18, 2020

APPROVED BY: Jayton Lindley

TPMS WRITTEN INSTRUCTIONS
DATA SHEET 4 (Sheet 1 of 3)

TEST **VEHICLE**
DATE: February 24, 2020 **LAB:** San Angelo Test Facility **NHTSA NO:** C20204100

The following statement, in the English language, is provided verbatim in the Owner's Manual. (X)YES ( )NO

"Each tire, including the spare (if provided), should be checked monthly when cold and inflated to the inflation pressure recommended by the vehicle manufacturer on the vehicle placard or tire inflation pressure label. (If your vehicle has tires of a different size than the size indicated on the vehicle placard or tire inflation pressure label, you should determine the proper tire inflation pressure for those tires.)

As an added safety feature, your vehicle has been equipped with a tire pressure monitoring system (TPMS) that illuminates a low tire pressure telltale when one or more of your tires is significantly under-inflated. Accordingly, when the low tire pressure telltale illuminates, you should stop and check your tires as soon as possible, and inflate them to the proper pressure. Driving on a significantly under-inflated tire causes the tire to overheat and can lead to tire failure. Under-inflation also reduces fuel efficiency and tire tread life, and may affect the vehicle's handling and stopping ability.

Please note that the TPMS is not a substitute for proper tire maintenance, and it is the driver's responsibility to maintain correct tire pressure, even if under-inflation has not reached the level to trigger illumination of the TPMS low tire pressure telltale."

TPMS WRITTEN INSTRUCTIONS
DATA SHEET 4 (Sheet 2 of 3)

As specified, the following sections, in the English language, are required verbatim in paragraph form in the Owner's Manual:

The following statement is required for all vehicles certified to the standard starting on September 1, 2007 and for vehicles voluntarily equipped with a compliant TPMS MIL before that time.

"Your vehicle has also been equipped with a TPMS malfunction indicator to indicate when the system is not operating properly."

The above statement in the English language is provided verbatim in owner's manual:
(X)YES ( )NO

For vehicles with a dedicated MIL telltale, add the following statement:

"The TPMS malfunction indicator is provided by a separate telltale, which displays the symbol "TPMS" when illuminated."

The above statement in the English language is provided verbatim in owner's manual:
( )YES ( )NO (X)N/A

For vehicles with a combined low tire pressure/MIL telltale, add the following statement:

"The TPMS malfunction indicator is combined with the low tire pressure telltale. When the system detects a malfunction, the telltale will flash for approximately one minute and then remain continuously illuminated. This sequence will continue upon subsequent vehicle start-ups as long as the malfunction exists."

The above statement in the English language is provided verbatim in owner's manual:
(X)YES ( )NO ( )N/A

The following statement is required for all vehicles certified to the standard starting on September 1, 2007 and for vehicles voluntarily equipped with a compliant TPMS MIL before that time.

"When the malfunction indicator is illuminated, the system may not be able to detect or signal low tire pressure as intended. TPMS malfunctions may occur for a variety of reasons, including the installation of replacement or alternate tires or wheels on the vehicle that prevent the TPMS from functioning properly. Always check the TPMS malfunction telltale after replacing one or more tires or wheels on your vehicle to ensure that the replacement or alternate tires and wheels allow the TPMS to continue to function properly."

The above statement in the English language is provided verbatim in owner's manual:
(X)YES ( )NO

DATA INDICATES COMPLIANCE: PASS/FAIL: **PASS**

REMARKS: NONE

TPMS WRITTEN INSTRUCTIONS
DATA SHEET 4 (Sheet 3 of 3)

Does the Owner's Manual provide an image of the Low Tire Pressure Warning Telltale symbol (and an image of the TPMS Malfunction Telltale warning ("TPMS"), if a dedicated telltale is utilized for this function)? (X)YES ( )NO

Does the Owner's Manual include the following (allowable) information?

- [x] Significance of the low tire pressure warning telltale illuminating
- [x] A description of corrective action to be undertaken
- [ ] Whether the tire pressure monitoring system functions with the vehicle's spare tire (if provided)
- [x] How to use a reset button, if one is provided
- [ ] The time for the TPMS telltale(s) to extinguish once the low tire pressure condition or the malfunction is corrected

REMARKS: None

RECORDED BY: Anthony Walden & Tommy Oliver DATE: February 24, 2020

APPROVED BY: Jayton Lindley

SECTION 4

TEST EQUIPMENT LIST AND CALIBRATION INFORMATION

EQUIPMENT	DESCRIPTION	MODEL/ SERIAL NO	CAL. DATE	NEXT CAL. DATE
AIR PRESSURE GAUGE	ASHCROFT GENERAL PURPOSE DIGITAL GAUGE	DG2551L2NAM02L 100# - XCA, #3093017001	12/20/2019	12/20/2020
FLOOR SCALES (VEHICLE & BALLAST)	INTERCOMP SW DELUXE SCALES	SERIAL #27032382-23746	11/04/2019	11/04/2020
DIGITAL THERMOMETER	FLUKE 50D	SERIAL #80840101	06/18/2019	06/18/2020
LASER TEMPERATURE GAUGE (TIRES AND GROUND)	RAYTEK MINITEMP MT6U	SERIAL # 30181378	03/18/2019	03/18/2020
VBOX RECORDING DEVICE	RACELOGIC VBOX 3iSL	SERIAL # 24491	11/07/2019	11/06/2020
STOPWATCH	ROBIC SC-505W STOPWATCH	N/A	N/A	N/A

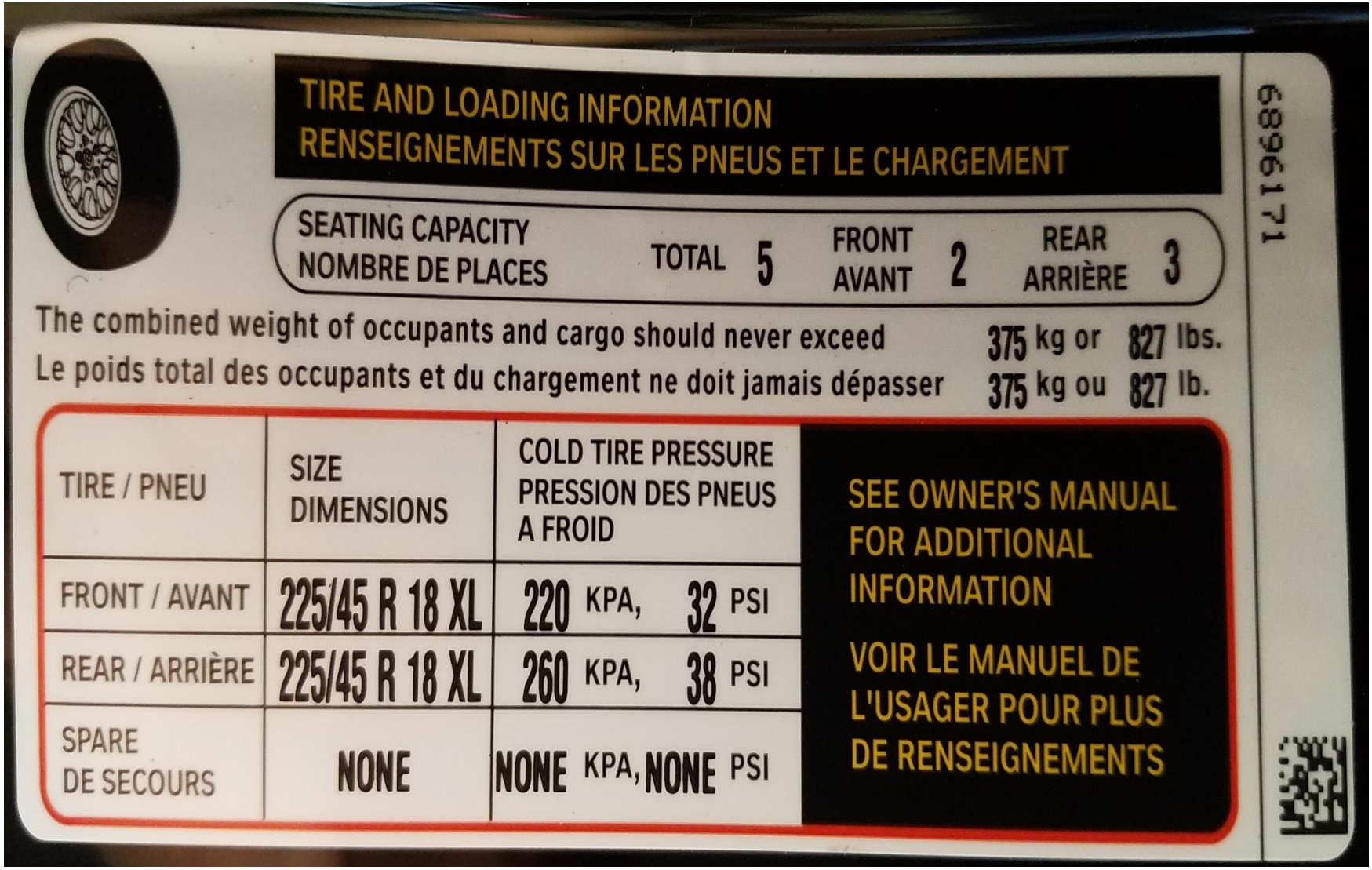
SECTION 5
PHOTOGRAPHS

2020 BMW 330i
NHTSA NO. C20204100
FMVSS NO. 138

FIGURE 5.1
THREE-QUARTER FRONT VIEW FROM LEFT SIDE OF VEHICLE

2020 BMW 330i
NHTSA NO. C20204100
FMVSS NO. 138

FIGURE 5.2
VEHICLE CERTIFICATION LABEL



2020 BMW 330i
NHTSA NO. C20204100
FMVSS NO. 138

FIGURE 5.3
VEHICLE PLACARD

2020 BMW 330i
NHTSA NO. C20204100
FMVSS NO. 138

FIGURE 5.4
TIRE SHOWING BRAND

2020 BMW 330i
NHTSA NO. C20204100
FMVSS NO. 138

FIGURE 5.5
TIRE SHOWING MODEL

2020 BMW 330i
NHTSA NO. C20204100
FMVSS NO. 138

FIGURE 5.6
TIRE SHOWING SIZE AND LOAD INDEX / SPEED RATING

2020 BMW 330i
NHTSA NO. C20204100
FMVSS NO. 138

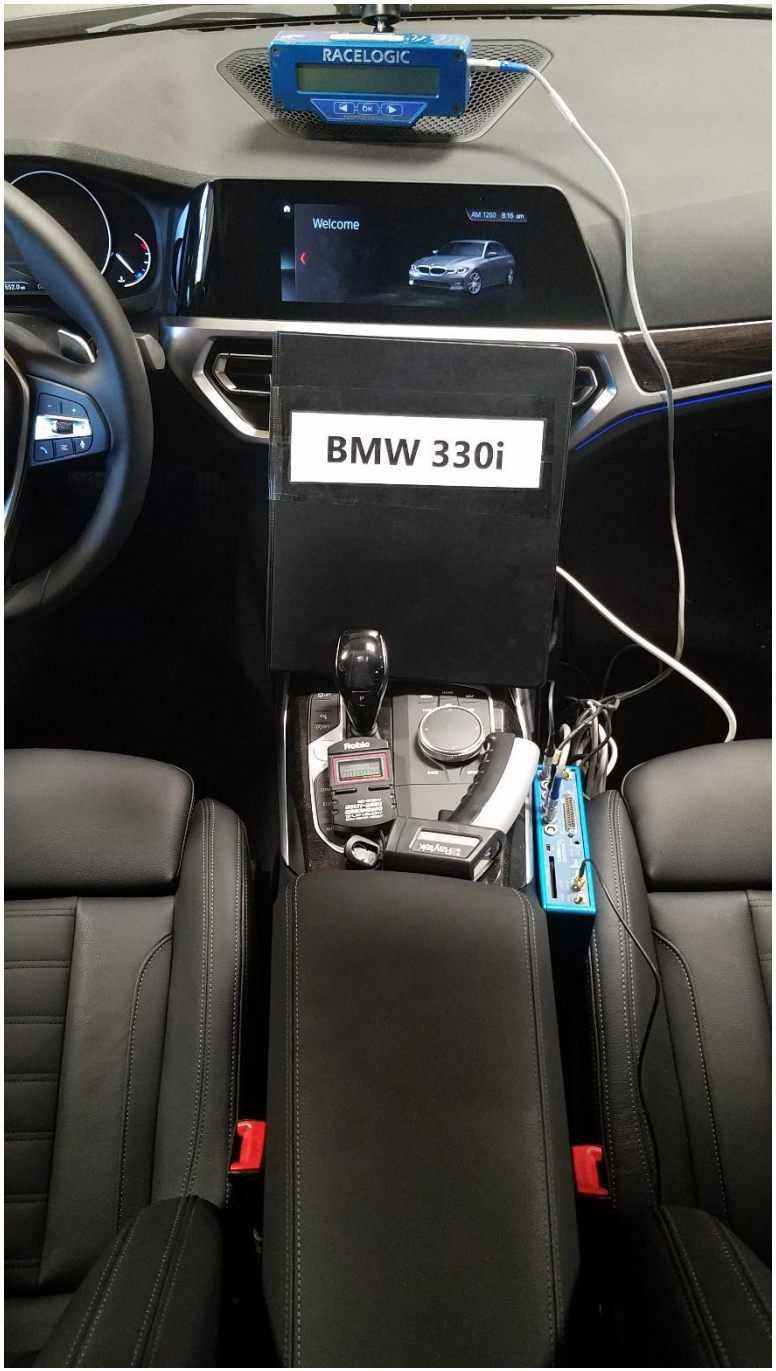
FIGURE 5.7
TIRE SHOWING DOT NUMBER

2020 BMW 330i
NHTSA NO. C20204100
FMVSS NO. 138

FIGURE 5.8
TIRE SHOWING MAX LOAD RATING
AND MAX COLD INFLATION PRESSURE

2020 BMW 330i
NHTSA NO. C20204100
FMVSS NO. 138

FIGURE 5.9
TIRE SHOWING SIDEWALL / TREAD CONSTRUCTION



2020 BMW 330i
NHTSA NO. C20204100
FMVSS NO. 138

FIGURE 5.10
TEST INSTRUMENTATION INSTALLED IN VEHICLE

2020 BMW 330i
NHTSA NO. C20204100
FMVSS NO. 138

FIGURE 5.11
REAR SEAT BALLAST FOR UVW+VCW GAWR LOAD

2020 BMW 330i
NHTSA NO. C20204100
FMVSS NO. 138

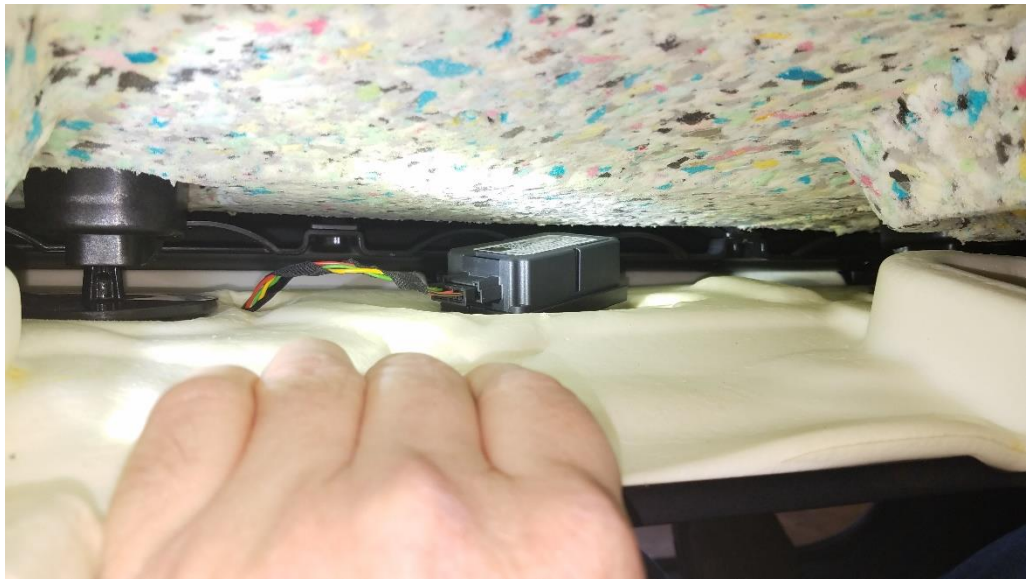
FIGURE 5.12
VEHICLE CARGO AREA BALLAST FOR UVW+VCW GAWR LOAD

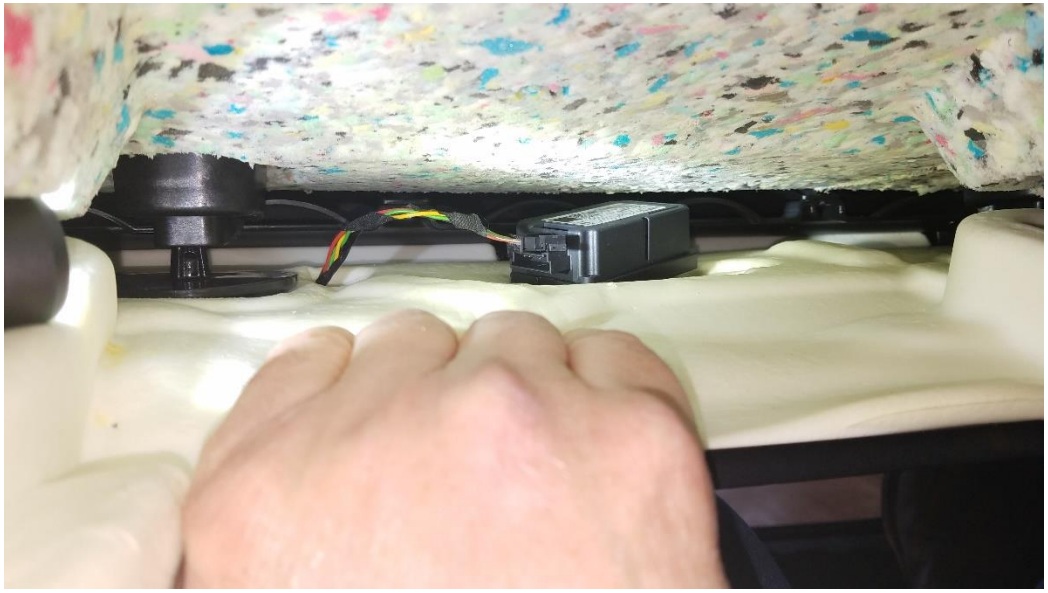
2020 BMW 330i
NHTSA NO. C20204100
FMVSS NO. 138

FIGURE 5.13
VEHICLE ON WEIGHT SCALES

2020 BMW 330i
NHTSA NO. C20204100
FMVSS NO. 138

FIGURE 5.14
MALFUNCTION DETECTION TEST 1
TPMS RIGHT FRONT SENSOR REMOVED AT LLVW





2020 BMW 330i
NHTSA NO. C20204100
FMVSS NO. 138

FIGURE 5.15
MALFUNCTION DETECTION TEST 2:
DISCONNECTED FBD4 MODULE
(RF RECEIVER FOR TPMS SENSORS) AT UVW+VCW

2020 BMW 330i
NHTSA NO. C20204100
FMVSS NO. 138

FIGURE 5.16
VEHICLE INSTRUMENT PANEL LAMP CHECK

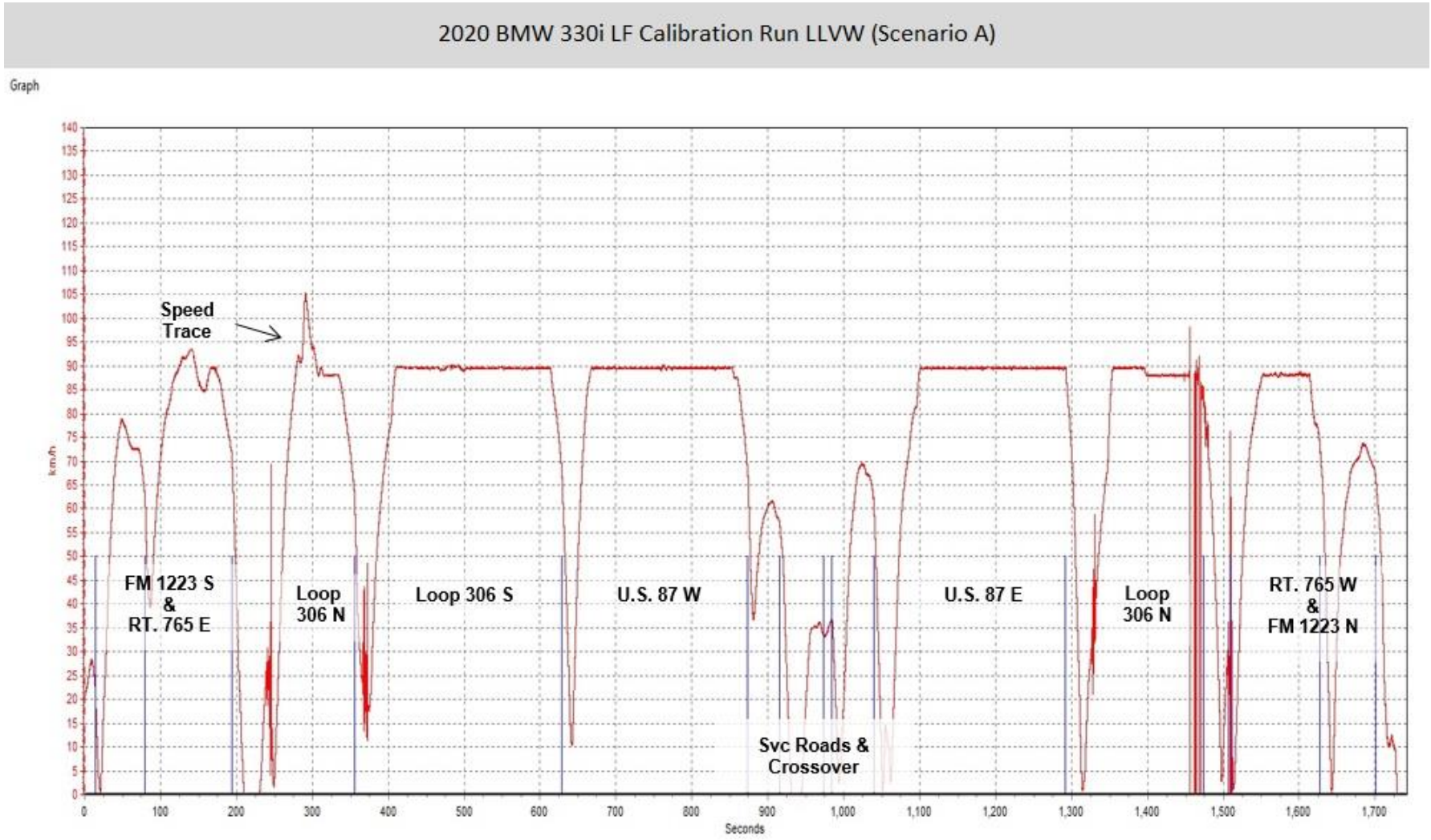
2020 BMW 330i
NHTSA NO. C20204100
FMVSS NO. 138

FIGURE 5.17
TPMS LOW TIRE PRESSURE TELLTALE ILLUMINATION

SECTION 6
TEST PLOTS

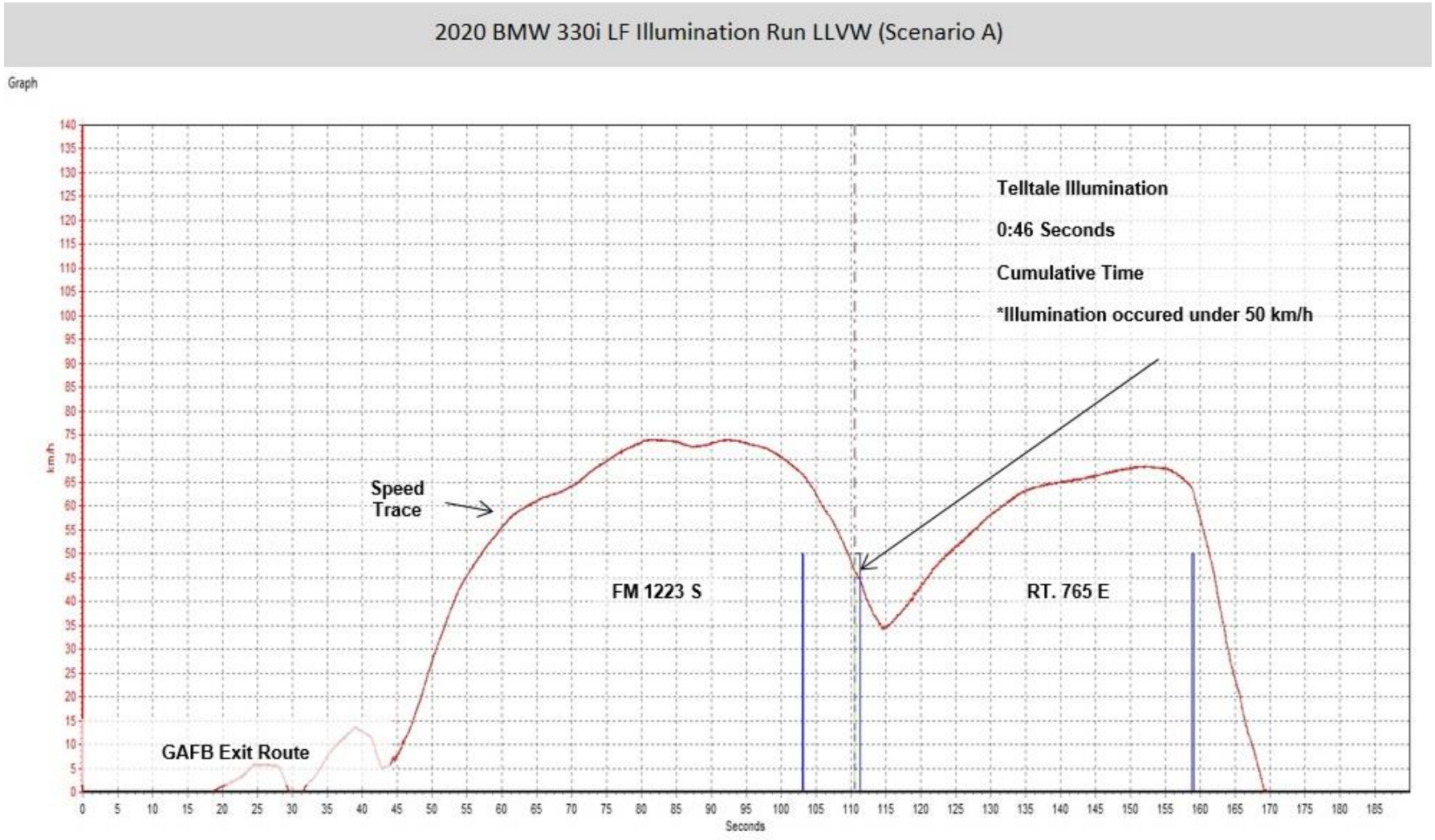
Scenario A: Left Front Tire at LLVW
Test Date: 01/21/20
Data File Time: 29:02 minutes
Cumulative Driving Time: 21:10 minutes
Start Point: GAFB South Gate

Calibration Phase:



Scenario A: Left Front Tire at LLVW
Test Date: 01/21/20
Data File Time: 3:10 minutes
Cumulative Driving Time: 0:46 seconds
Start Point: GAFB South Gate

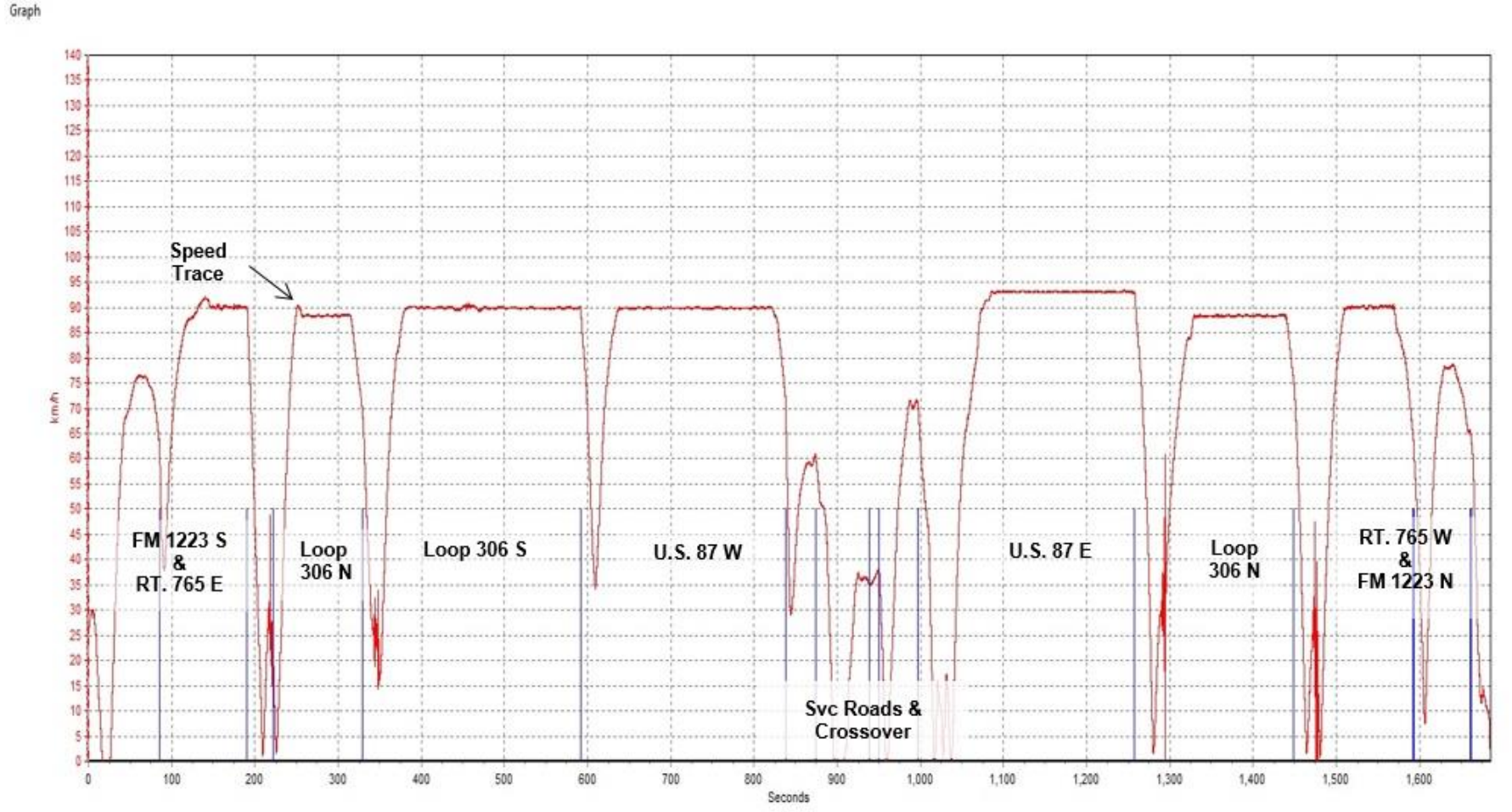
Detection Phase:



Scenario B:	Left Front and Left Rear Tires at LLVW
Test Date:	01/22/20
Data File Time:	28:06 minutes
Cumulative Driving Time:	20:46 minutes
Start Point:	GAFB South Gate

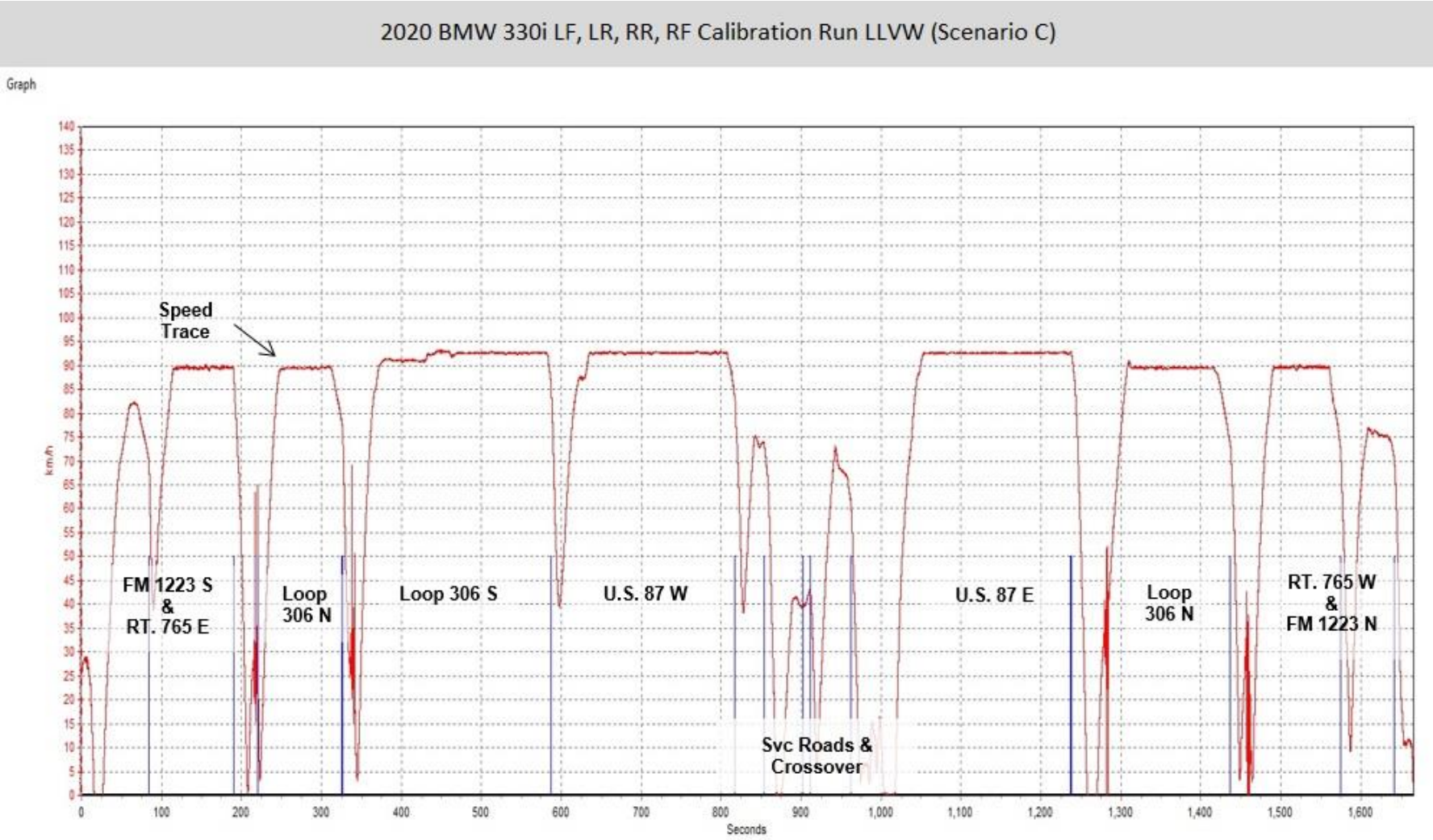
Calibration Phase:

2020 BMW 330i LF, LR Calibration Run LLVW (Scenario B)



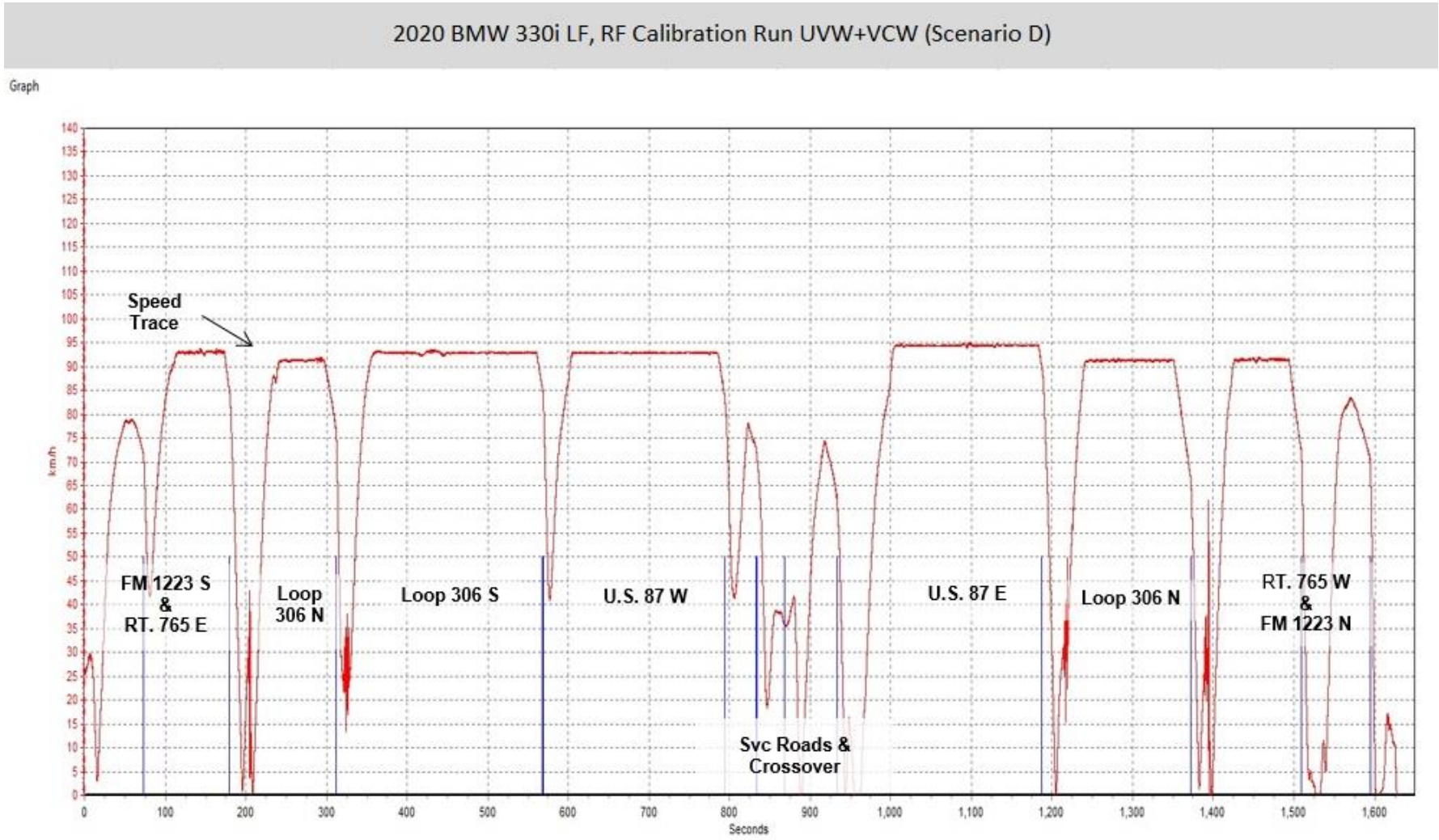
Scenario C:	Left Front, Left Rear, Right Rear, and Right Front Tires at LLVW
Test Date:	01/22/20
Data File Time:	27:47 minutes
Cumulative Driving Time:	20:41 minutes
Start Point:	GAFB South Gate

Calibration Phase:



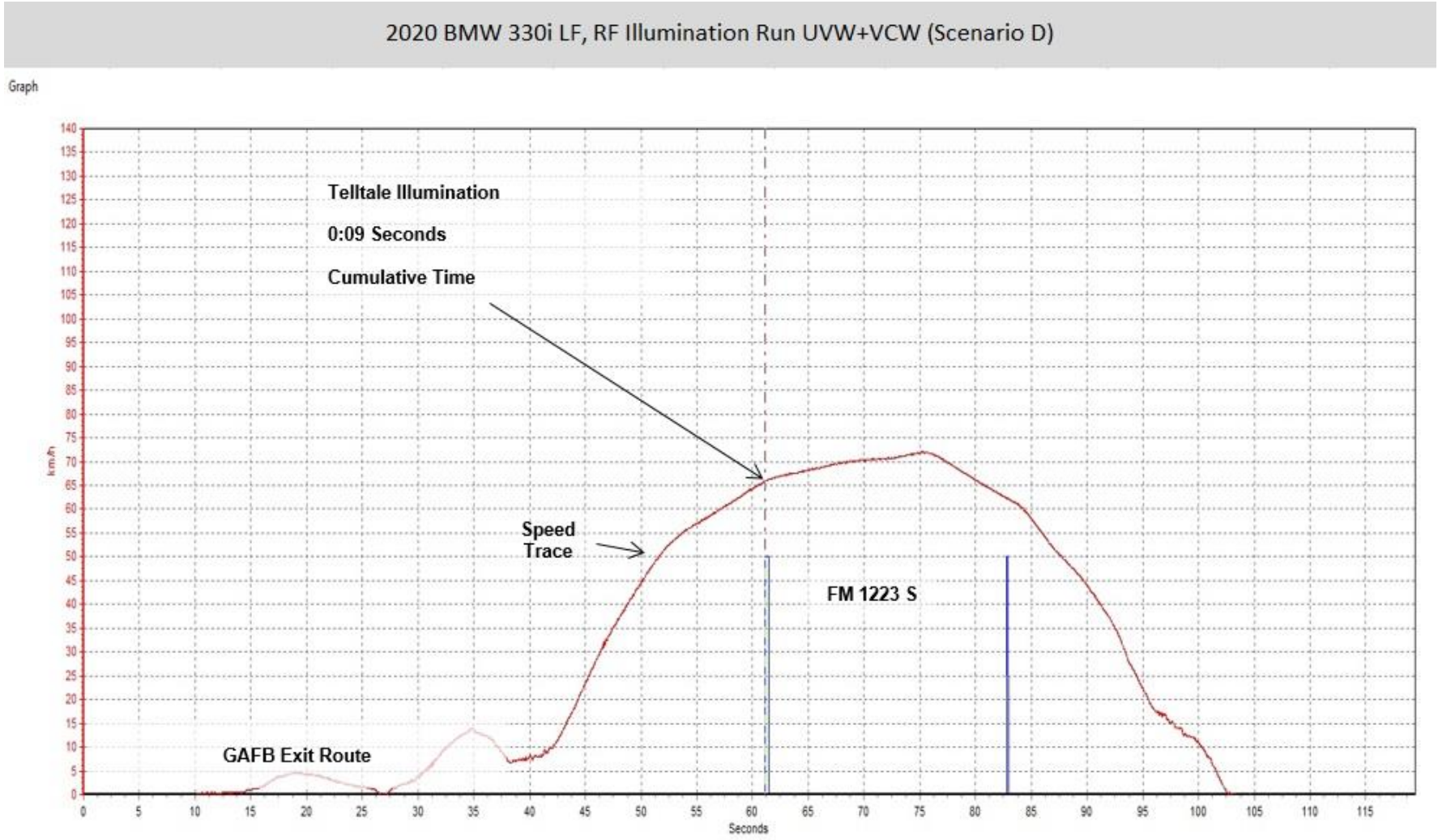
Scenario D:	Left Front and Right Front Tires at UVW+VCW
Test Date:	2/4/20
Data File Time:	27:30 minutes
Cumulative Driving Time:	20:38 minutes
Start Point:	GAFB South Gate

Calibration Phase:



Scenario D: Left Front and Right Front Tires at UVW+VCW
Test Date: 2/4/20
Data File Time: 2:00 minutes
Cumulative Driving Time: 0:09 seconds
Start Point: GAFB South Gate

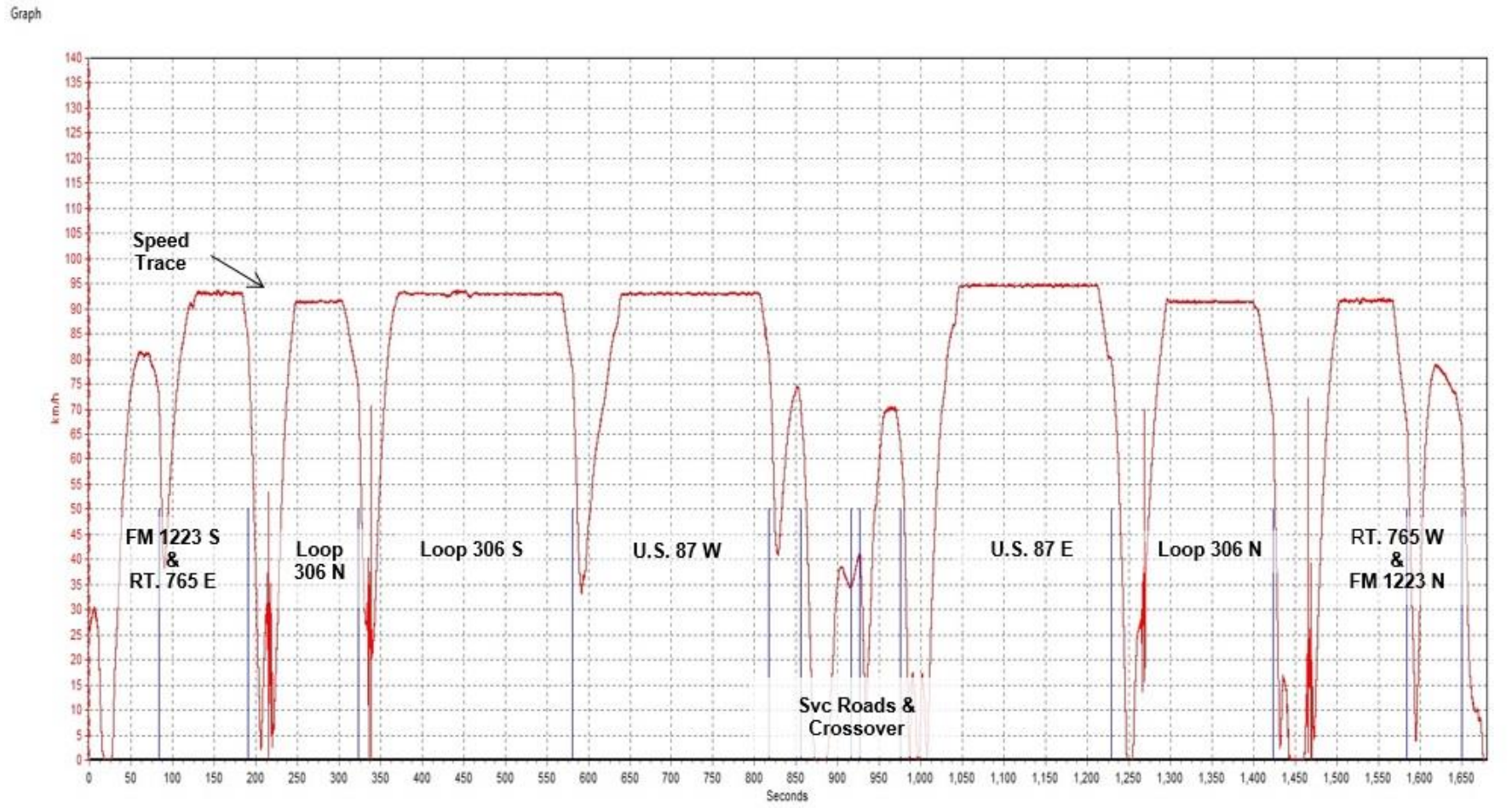
Detection Phase:



Scenario E:	Left Rear, Right Rear, and Right Front Tires at UVW+VCW
Test Date:	2/7/20
Data File Time:	28:00 minutes
Cumulative Driving Time:	20:40 minutes
Start Point:	GAFB South Gate

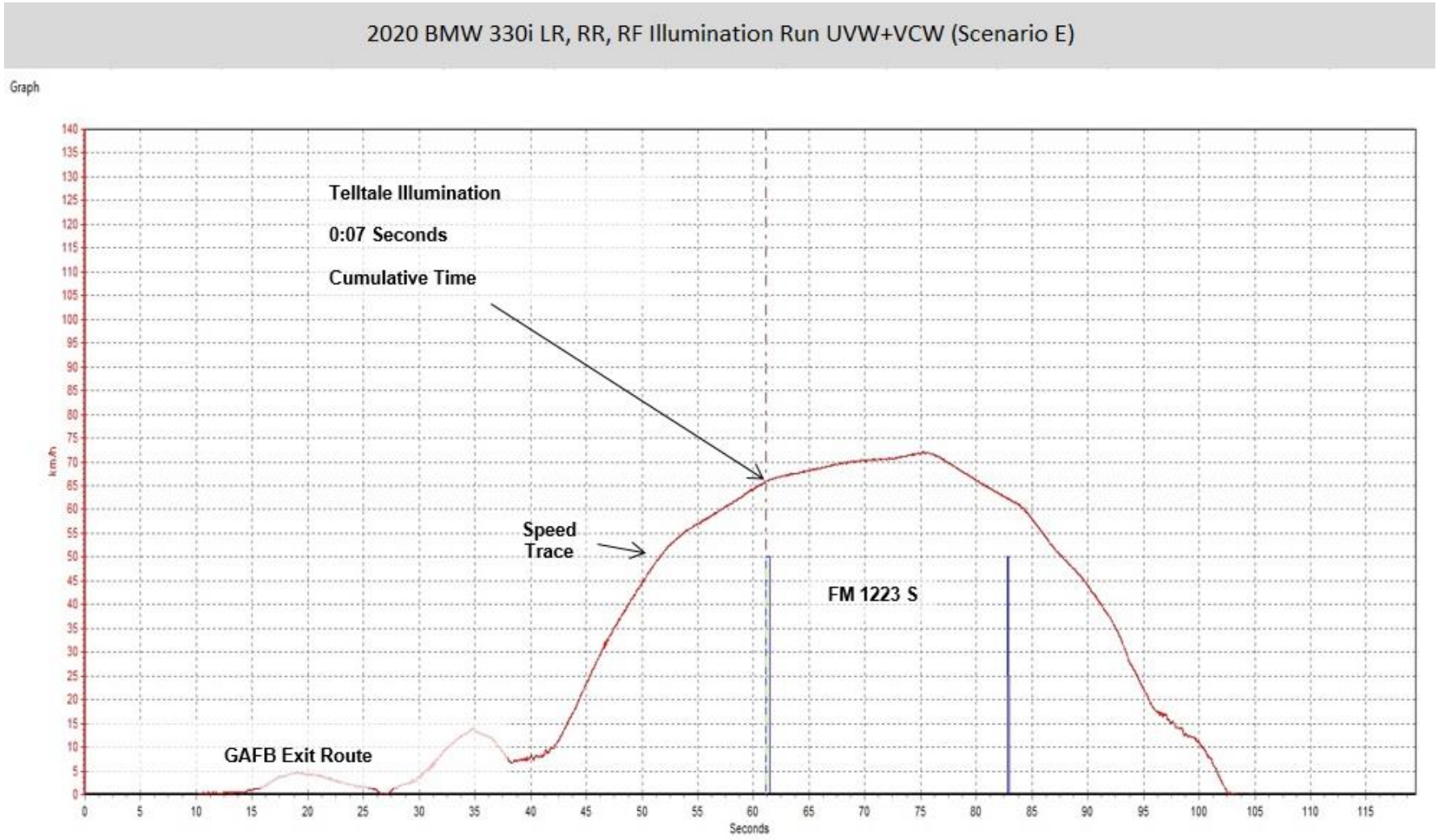
Calibration Phase:

2020 BMW 330i LR, RR, RF Calibration Run UVW+VCW (Scenario E)



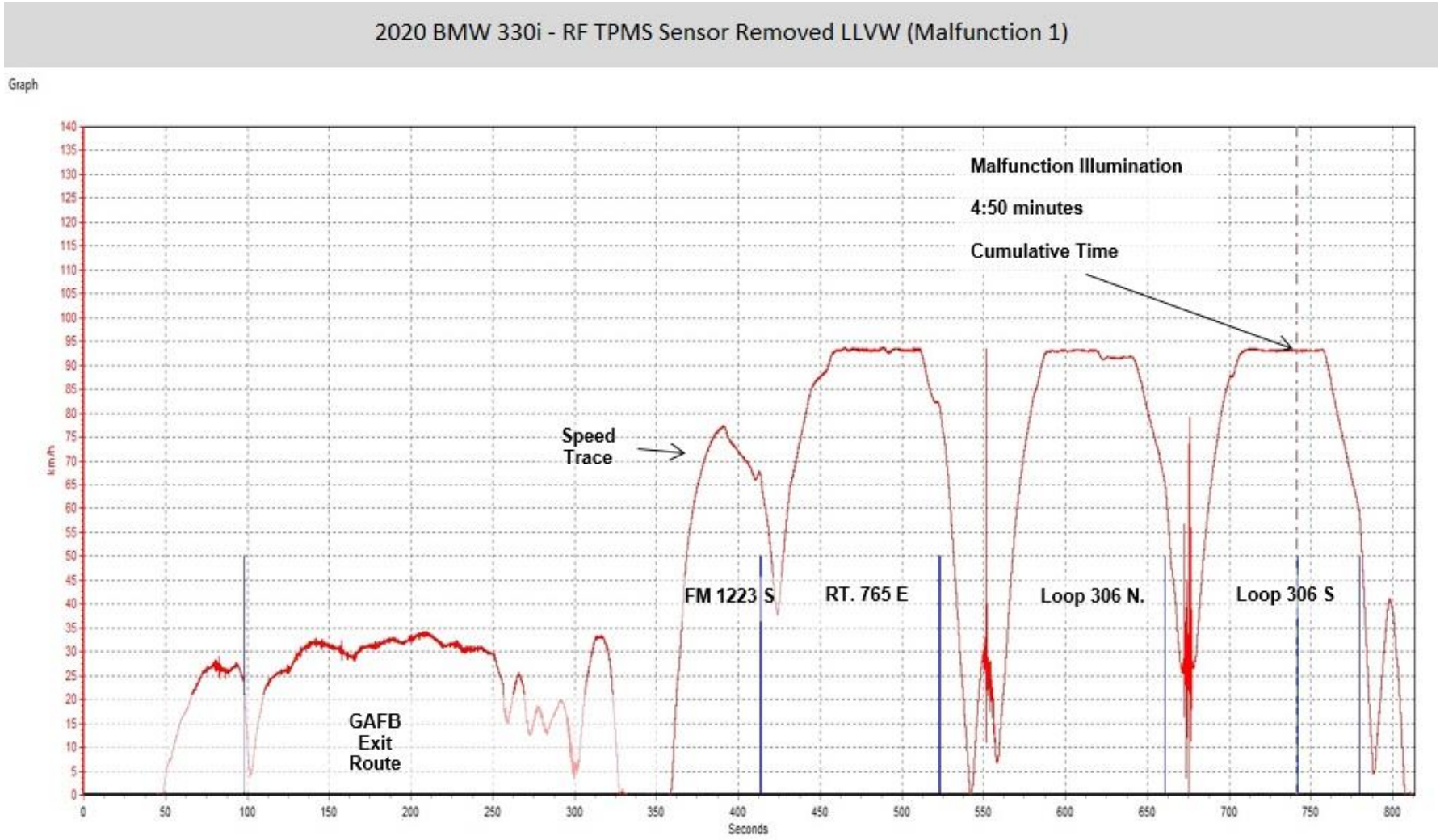
Scenario E: Left Rear, Right Rear, and Right Front Tires at UVW+VCW
Test Date: 2/7/20
Data File Time: 1:30 minutes
Cumulative Driving Time: 0:07 seconds
Start Point: GAFB South Gate

Detection Phase:



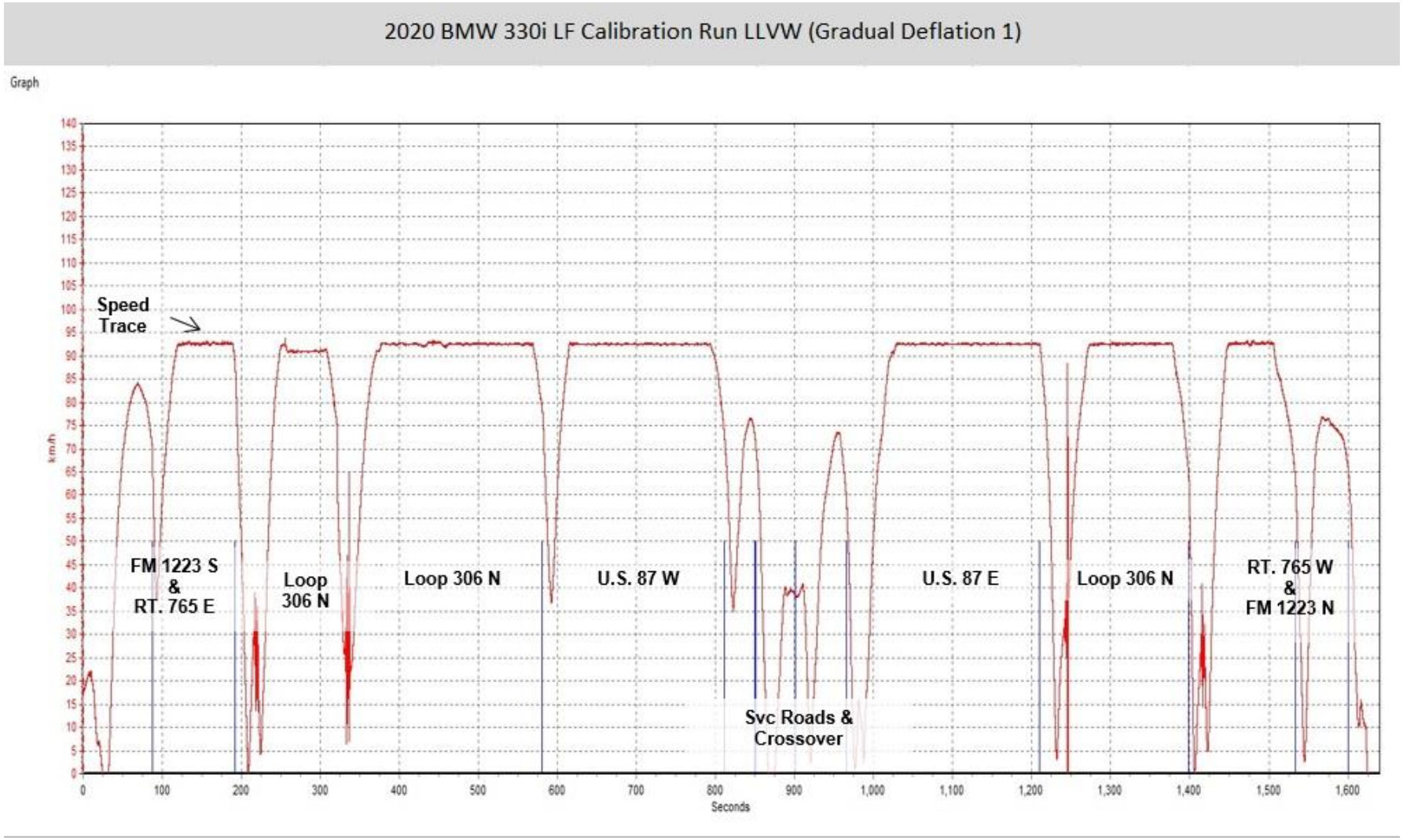
Malfunction 1: TPMS Right Front Sensor Removed at LLVW
Test Date: 1/28/20
Data File Time: 13:33 minutes
Cumulative Driving Time: 4:50 minutes
Start Point: GAFB South Gate

Detection Phase:



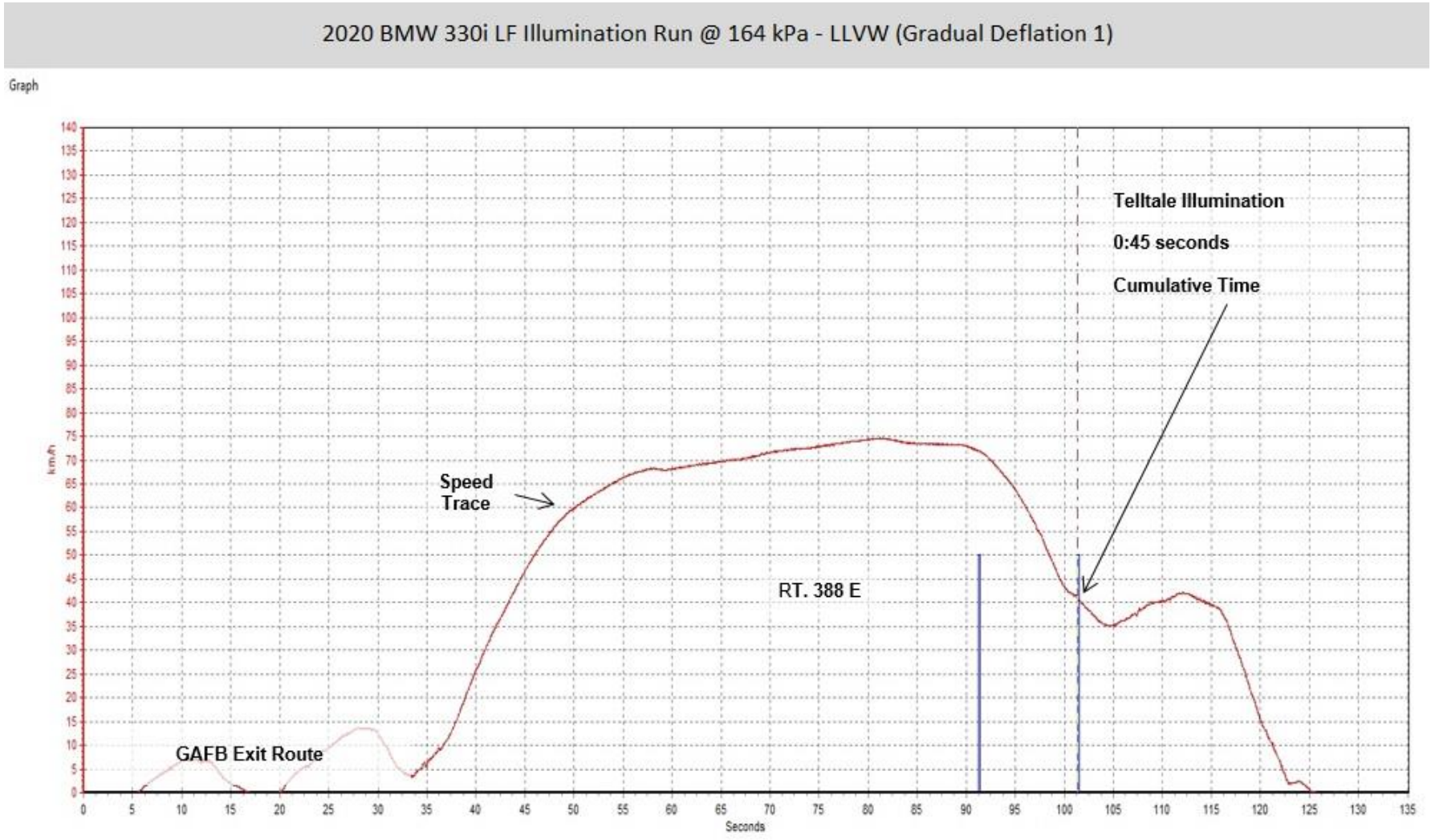
Gradual Deflation 1:	Left Front Tires at LLVW – Calibration at 220 kPa
Test Date:	1/29/20
Data File Time:	27:20 minutes
Cumulative Driving Time:	20:34 minutes
Start Point:	GAFB South Gate

Calibration Phase:



Gradual Deflation 1: Left Front Tires at LLVW – Illumination at 164 kPa
Test Date: 1/29/20
Data File Time: 2:15 minutes
Cumulative Driving Time: 0:45 seconds
Start Point: GAFB South Gate

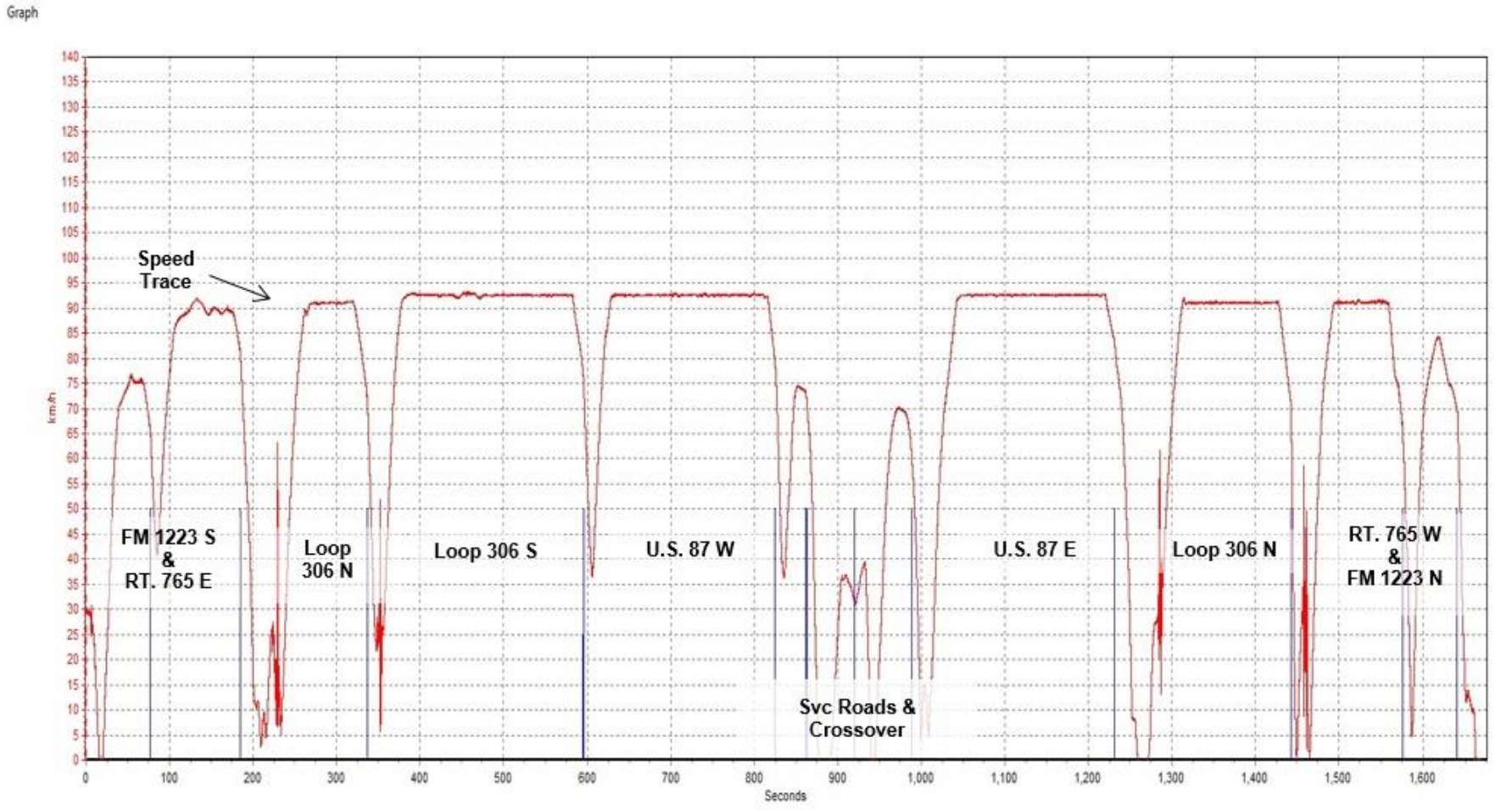
Detection Phase:



Gradual Deflation 2:	Left Rear and Right Front Tires at LLVW – Calibration at 260 kPa and 220 kPa
Test Date:	2/3/20
Data File Time:	27:57 minutes
Cumulative Driving Time:	20:41 minutes
Start Point:	GAFB South Gate

Calibration Phase:

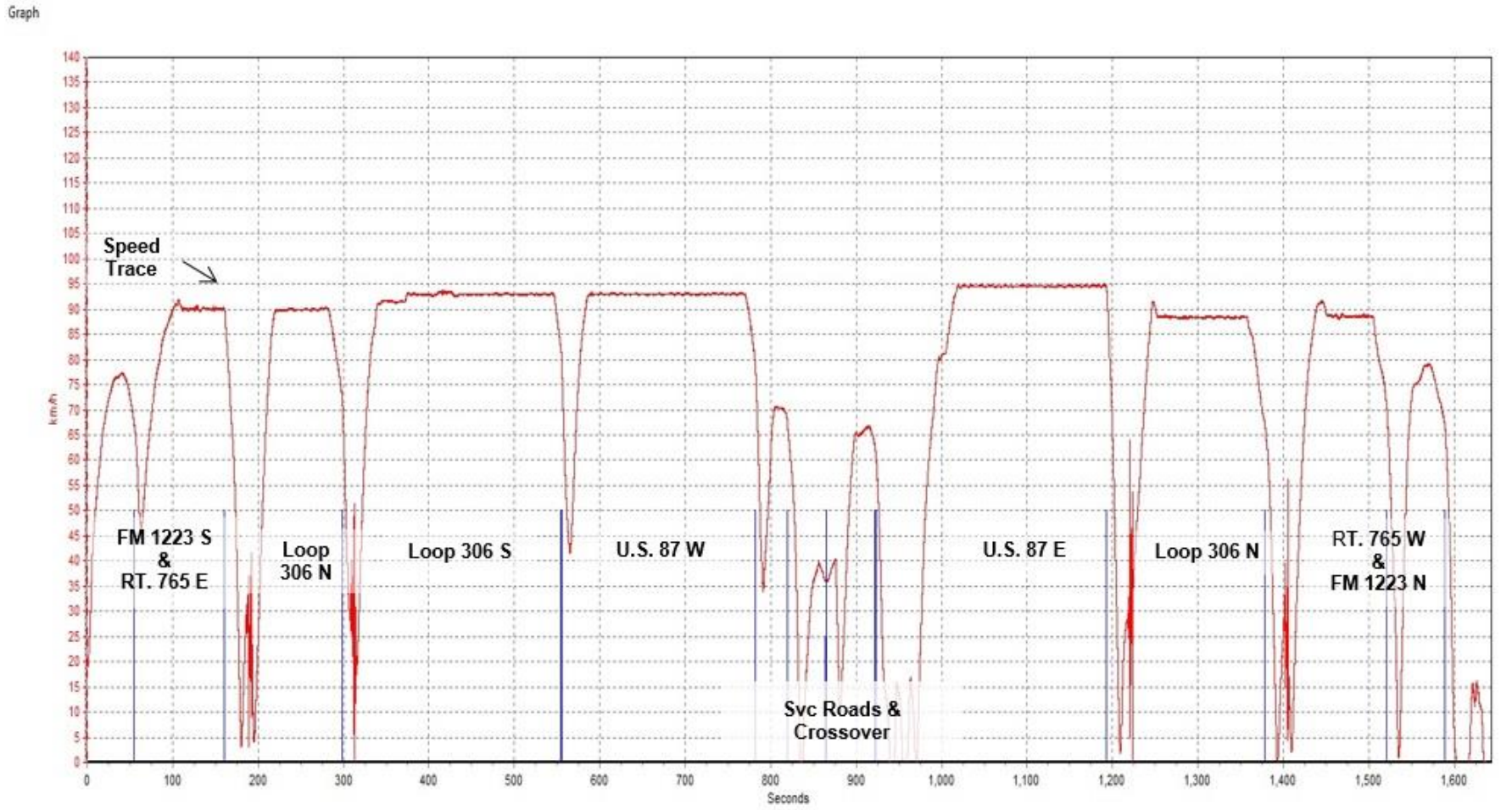
2020 BMW 330i LR, RF Calibration Run LLVW (Gradual Deflation 2)



Gradual Deflation 3:	Left Front, Left Rear, and Right Rear Tires at UVW+VCW – Calibration at 220 kPa and 260 kPa
Test Date:	2/24/20
Data File Time:	27:24 minutes
Cumulative Driving Time:	20:40 minutes
Start Point:	GAFB South Gate

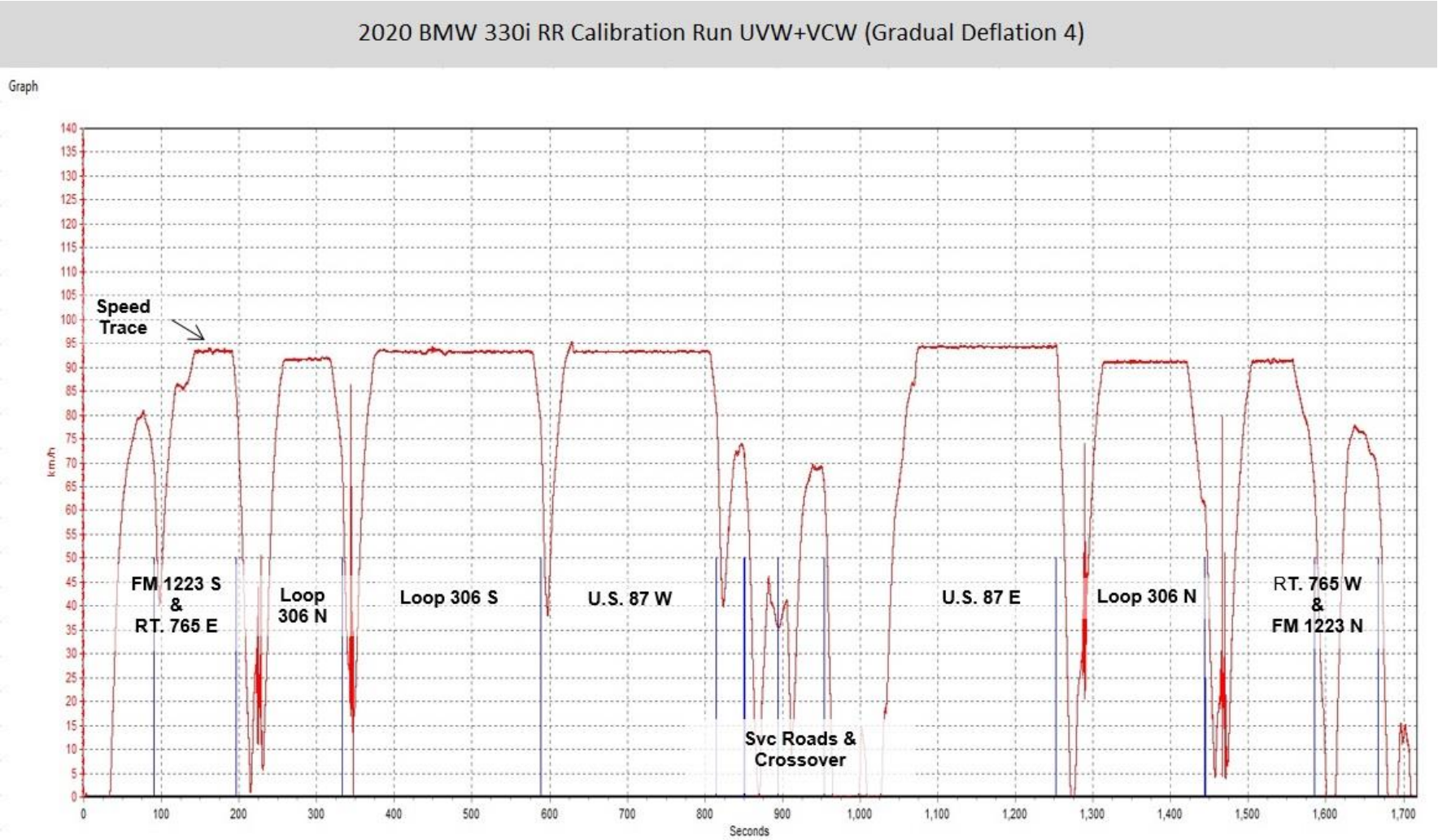
Calibration Phase:

2020 BMW 330i LF, LR, RR Calibration Run LLVW (Gradual Deflation 3)



Gradual Deflation 4: Right Rear Tire at UVW+VCW – Calibration at 260 kPa
Test Date: 2/13/20
Data File Time: 28:37 minutes
Cumulative Driving Time: 20:41 minutes
Start Point: GAFB South Gate

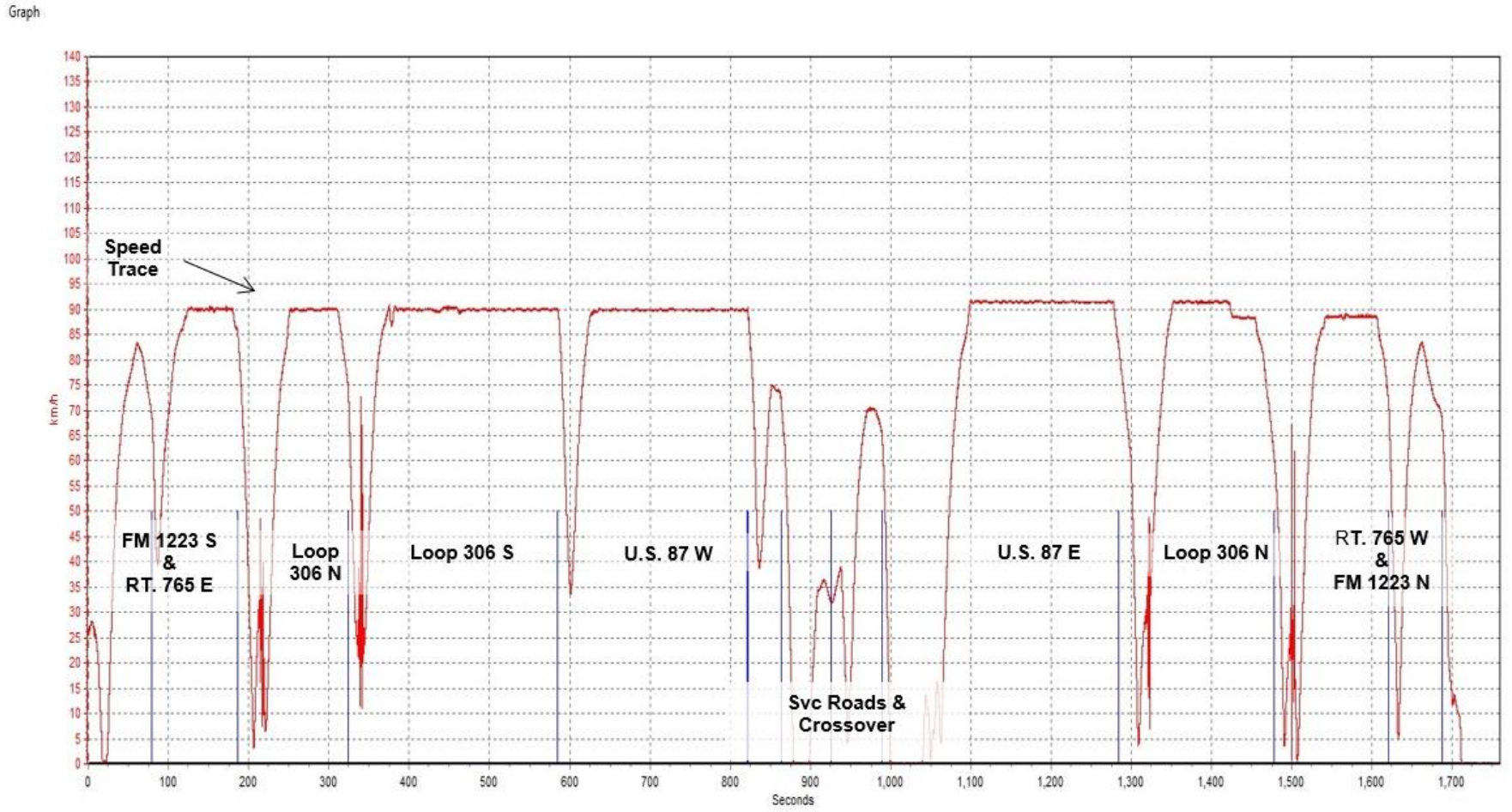
Calibration Phase:



Gradual Deflation 5: Right Rear and Right Front Tires at UVW+VCW – Calibration at 260 kPa and 220 kPa
Test Date: 2/18/20
Data File Time: 29:19 minutes
Cumulative Driving Time: 20:41 minutes
Start Point: GAFB South Gate

Calibration Phase:

2020 BMW 330i RR, RF Calibration Run UVW+VCW (Gradual Deflation 5)



SECTION 7
OWNER'S MANUAL PAGES

center or another qualified service center or repair shop.

If a tire inflation pressure of at least 2 bar is reached, see Minimum tire inflation pressure is reached.

6. Unscrew the connection hose of the compressor from the tire valve.
7. Pull the connector out of the power socket inside the vehicle.
8. Stow the Mobility System in the vehicle.

Minimum tire inflation pressure is reached

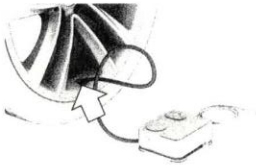
1. Unscrew the connection hose of the compressor from the tire valve.
2. Pull the connector out of the power socket inside the vehicle.
3. Stow the Mobility System in the vehicle.
4. Immediately drive approx. 5 miles/10 km to ensure that the sealant is evenly distributed in the tire.

   Do not exceed a speed of 50 mph/80 km/h.

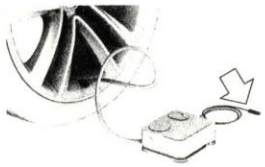
   If possible, do not drive at speeds less than 12 mph/20 km/h.

Adjustment

1. Stop at a suitable location.
2. Screw the connection hose of the compressor directly onto the tire valve stem.



3. Insert the connector into the power socket inside the vehicle.



4. Correct the tire inflation pressure to at least 2.0 bar.
   - ▷ Increase tire inflation pressure: with standby state switched on or the engine running, switch on the compressor.
   - ▷ Reduce tire inflation pressure: press the button on the compressor.
5. Unscrew the connection hose of the compressor from the tire valve.
6. Pull the connector out of the power socket inside the vehicle.
7. Stow the Mobility System in the vehicle.

Continuing the trip

Do not exceed the maximum permissible speed of 50 mph/80 km/h.

Reinitialize the run-flat tires, refer to page 294.

Reset the Tire Pressure Monitor TPM, refer to page 287.

Replace the nonworking tire and the sealant container of the Mobility System promptly.

Snow chains

Safety information

⚠ Warning

With the mounting of snow chains on unsuitable tires, the snow chains can come into contact with vehicle parts. There may be a risk of accident or risk of damage to property. Only mount snow chains on tires that are designated by their manufacturer as suitable for the use of snow chains.

⚠ Warning

Insufficiently tight snow chains may damage tires and vehicle components. There may be a risk of accident or risk of damage to property. Make sure that the snow chains are always sufficiently tight. Re-tighten as needed according to the snow chain manufacturer's instructions.

Fine-link snow chains

The manufacturer of the vehicle recommends the use of fine-link snow chains. Certain types of fine-link snow chains have been tested by the manufacturer of the vehicle and recommended as road-safe and suitable.

Information regarding suitable snow chains is available from a dealer's service center or another qualified service center or repair shop.

Use

Use only in pairs on the rear wheels, equipped with the tires of the following size:

- ▷ 225/50 R17.
- ▷ 225/45 R18.

Follow the snow chain manufacturer's instructions.

Do not initialize the Flat Tire Monitor after mounting snow chains, as doing so may result in incorrect readings.

Do not reset the Tire Pressure Monitor TPM after mounting snow chains, as doing so may result in incorrect readings.

When driving with snow chains, briefly activate Dynamic Traction Control DTC to optimize the forward momentum.

Maximum speed with snow chains

Do not exceed a speed of 30 mph/50 km/h when using snow chains.

Tire Pressure Monitor TPM

Concept

The system monitors tire inflation pressure in the four mounted tires. The system warns you if there is a loss of pressure in one or more tires.

General information

Sensors in the tire valves measure the tire inflation pressure and tire temperature.

The system detects the mounted tires automatically. The system displays the specified nominal pressure values on the Control Display and compares these values to the actual tire pressure values.

If tires are being used that are not specified on the tire inflation pressure details on the vehicle, refer to page 272, such as tires with special approval, the system needs to be actively reset. The system will then take over the actual tire inflation pressures as the target pressures.

When operating the system, also note the additional information found in the Tire inflation pressure, refer to page 272, chapter.

The wheels are displayed in gray and the following is displayed "Resetting Tire Pressure Monitor...".

After a travel time of several minutes, the set tire inflation pressures are accepted as the target tire inflation pressures. The reset is completed automatically while driving.

After a successfully completed reset, the wheels on the Control Display are shown in green and the following is displayed: "Tire Pressure Monitor active. See label for recommended pressures.".

You may interrupt this trip at any time. When you continue the reset resumes automatically.

Messages: for tires without special approval

General information

A low tire inflation pressure may cause the DSC Dynamic Stability Control to be switched on.

Safety information

⚠ Warning

A damaged regular tire with low or missing tire inflation pressure impacts handling, such as steering and braking response. Run-flat tires can maintain limited stability. There is a risk of accident. Do not continue driving if the vehicle is equipped with normal tires. Follow the information on run-flat tires and continued driving with these tires.

If a tire inflation pressure check is required

Message

A symbol with a Check Control message appears on the Control Display.

Symbol	Possible cause
	Inflation was not carried out according to specifications, e.g., when the tire has not been sufficiently inflated or in the case of a natural steady tire pressure loss.

Measure

Check the tire pressure and correct as needed.

If the tire inflation pressure is too low

Message

 A yellow warning light is illuminated in the instrument cluster.

In addition, a symbol with a Check Control message appears on the Control Display.

Symbol	Possible cause
	There is a tire inflation pressure loss.

Measure

1. Reduce the vehicle speed. Do not exceed a speed of 80 mph/130 km/h.
2. At the next opportunity, for instance at a gas station, check the tire inflation pressure in all four tires and correct if necessary.

If there is a significant loss of tire inflation pressure

Message

 A yellow warning light is illuminated in the instrument cluster.

In addition, a symbol with the affected tire appears in a Check Control message on the Control Display.

Symbol	Possible cause
	There is a flat tire or a major loss in tire inflation pressure.

Measure

1. Reduce your speed and stop cautiously. Avoid sudden braking and steering maneuvers.
2. Check whether the vehicle is fitted with normal tires or run-flat tires.

   Run-flat tires, refer to page 281, are labeled with a circular symbol containing the letters RSC marked on the tire's sidewall.
1. Read the description on What to do in case of a flat tire, refer to page 292.

Messages: for tires with special approval

General information

A low tire inflation pressure may cause the DSC Dynamic Stability Control to be switched on.

Safety information

⚠ Warning

A damaged regular tire with low or missing tire inflation pressure impacts handling, such as steering and braking response. Run-flat tires can maintain limited stability. There is a risk of accident. Do not continue driving if the vehicle is equipped with normal tires. Follow the information on run-flat tires and continued driving with these tires.

If a tire inflation pressure check is required

Message

A symbol with a Check Control message appears on the Control Display.

Symbol	Possible cause
	Inflation was not carried out according to specifications, e.g., the tire has not been sufficiently inflated. The system has detected a wheel change, but no reset was done. The tire inflation pressure has fallen below the level of the last reset. No reset was performed for the system. The system issues a warning based on the tire inflation pressures stored during the last reset.

Measure

1. Check the tire pressure and correct as needed.
2. Perform a system reset.

If the tire inflation pressure is too low

Message

 A yellow warning light is illuminated in the instrument cluster.

In addition, a symbol with a Check Control message appears on the Control Display.

Symbol	Possible cause
	There is a tire inflation pressure loss. No reset was performed for the system. The system issues a warning based on the tire inflation pressures stored during the last reset.

Measure

1. Reduce the vehicle speed. Do not exceed a speed of 80 mph/130 km/h.
2. At the next opportunity, for instance at a gas station, check the tire inflation pressure in all four tires and correct if necessary.

3. Reset the system.

If there is a significant loss of tire inflation pressure

Message

A yellow warning light is illuminated in the instrument cluster.

In addition, a symbol with the affected tire appears in a Check Control message on the Control Display.

Symbol	Possible cause
	There is a flat tire or a major loss in tire inflation pressure. No reset was performed for the system. The system issues a warning based on the tire inflation pressures stored during the last reset.

Measure

1. Reduce your speed and stop cautiously. Avoid sudden braking and steering maneuvers.
2. Check whether the vehicle is fitted with normal tires or run-flat tires.

   Run-flat tires, refer to page 281, are labeled with a circular symbol containing the letters RSC marked on the tire's sidewall.

1. Read the description on What to do in case of a flat tire, refer to page 292.

Actions in the event of a flat tire

Normal tires

1. Identify the damaged tire.

   Check the tire inflation pressure in all four tires, for instance using the tire pressure gage of a flat tire kit.

   For tires with special approval: if the tire inflation pressure in all four tires is correct, the TPM may not have been reset. In this case, perform the reset.

   If tire damage cannot be found, contact a dealer's service center or another qualified service center or repair shop.
2. Repair the flat tire, e.g., with a flat tire kit or by changing the wheel.

Use of sealant, for instance from the flat tire kit, may damage the TPM wheel electronics. Have the electronics replaced at the next opportunity.

Run-flat tires

Safety information

⚠ Warning

Your vehicle handles differently with a run-flat tire with no or low inflation pressure; for instance, your lane stability when braking is reduced, braking distances are longer and the self-steering properties will change. There is a risk of accident. Drive moderately and do not exceed a speed of 50 mph/80 km/h.

Maximum speed

You may continue driving with a damaged tire at speeds up to 50 mph/80 km/h.

Continued driving with a flat tire

Follow the following when continuing to drive with a damaged tire:

1. Avoid sudden braking and steering maneuvers.
2. Do not exceed a speed of 50 mph/80 km/h.
3. Check the tire inflation pressure in all four tires at the next opportunity.

Possible driving range with a depressurized tire

The distance for which it may be possible to drive safely varies depending on how the vehicle is loaded and used, e.g., speed, road conditions, external temperature. The driving range may be less but may also be more if an economical driving style is used.

If the vehicle is loaded with an average weight and used under favorable conditions, the distance for which it may be safe to drive may be up to 50 miles/80 km.

Vehicle handling with damaged tires

Vehicles driven with a damaged tire will handle differently, potentially leading to conditions such as the following:

- Greater likelihood of swerving off course.
- Longer braking distances.
- Changed self-steering properties.

Modify your driving style. Avoid abrupt steering maneuvers or driving over obstacles, for instance curbs or potholes.

Final tire failure

Vibrations or loud noises while driving can indicate the final failure of a tire.

Reduce speed and stop; otherwise, pieces of the tire could come loose and cause an accident.

Do not continue driving. Contact a dealer's service center or another qualified service center or repair shop.

System limits

Temperature

The tire inflation pressure depends on the tire's temperature.

Driving or exposure to the sun will increase the tire's temperature, thus increasing the tire inflation pressure.

The tire inflation pressure is reduced when the tire temperature falls again.

These circumstances may cause a warning when temperatures fall very sharply.

Following a temperature-related warning, the target pressures are displayed on the Control Display again after a short distance.

Sudden tire pressure loss

The system cannot indicate sudden serious tire damage caused by external circumstances.

Failure performing a reset

Tires with special approval: the system will not function correctly if a reset was not performed, for example a flat tire may be indicated although the tire inflation pressures are correct.

Malfunction

Message

The yellow warning light flashes and is then illuminated continuously. A Check Control message is displayed. It may not be possible to identify tire pressure losses.

Measure

- A wheel without TPM wheel electronics, such as an emergency wheel, is mounted: have the wheels checked, if needed.
- Malfunction: have the system checked.
- Interference caused by systems or devices with the same radio frequency: after leaving the area of the interference, the system automatically becomes active again.
- For tires with special approval: the system was unable to complete the reset. Perform a system reset again.

Declaration according to NHTSA/ FMVSS 138 Tire Pressure Monitoring System

Each tire, including the spare (if provided) should be checked monthly when cold and inflated to the inflation pressure recommended by the vehicle manufacturer on the vehicle placard or tire inflation pressure label. (If your vehicle has tires of

a different size than the size indicated on the vehicle placard or tire inflation pressure label, you should determine the proper tire inflation pressure for those tires.) As an added safety feature, your vehicle has been equipped with a tire pressure monitoring system (TPMS) that illuminates a low tire pressure telltale when one or more of your tires is significantly under-inflated. Accordingly, when the low tire pressure telltale illuminates, you should stop and check your tires as soon as possible, and inflate them to the proper pressure. Driving on a significantly under-inflated tire causes the tire to overheat and can lead to tire failure. Under-inflation also reduces fuel efficiency and tire tread life, and may affect the vehicle's handling and stopping ability. Please note that the TPMS is not a substitute for proper tire maintenance, and it is the driver's responsibility to maintain correct tire pressure, even if underinflation has not reached the level to trigger illumination of the TPMS low tire pressure telltale. Your vehicle has also been equipped with a TPMS malfunction indicator to indicate when the system is not operating properly. The TPMS malfunction indicator is combined with the low tire pressure telltale. When the system detects a malfunction, the telltale will flash for approximately one minute and then remain continuously illuminated. This sequence will continue upon subsequent vehicle start-ups as long as the malfunction exists. When the malfunction indicator is illuminated, the system may not be able to detect or signal low tire pressure as intended. TPMS malfunctions may occur for a variety of reasons, including the installation of replacement or alternate tires or wheels on the vehicle that prevent the TPMS from functioning properly. Always check the TPMS malfunction telltale after replacing one or more tires or wheels on your vehicle to ensure that the replacement or alternate tires and wheels allow the TPMS to continue to function properly.

Flat Tire Monitor FTM

Concept

The system detects tire inflation pressure loss on the basis of rotation speed differences between the individual wheels while driving.

In the event of a tire inflation pressure loss, the diameter and therefore the rotational speed of the corresponding wheel changes. The difference will be detected and reported as a flat tire.

The system does not measure the actual inflation pressure in the tires.

Functional requirements

The following conditions must be met for the system; otherwise, reliable flagging of a loss of tire inflation pressure is not assured:

- After a tire or wheel replacement, an initialization was performed with the correct tire inflation pressure.
- After the tire pressure was adjusted to a new value, an initialization was performed.

Status display

The current status of the flat tire monitor can be displayed, for instance whether the RPA is active.

Via iDrive:

1. "My Vehicle"
2. "Vehicle status"
3. (!) "Flat Tire Monitor"

The status is displayed.

Initialization required

An initialization must be performed in the following situations:

- After the tire inflation pressure has been adjusted.
- After a tire or wheel replacement.

Performing initialization

When initializing, the set tire inflation pressures serve as reference values in order to detect a flat tire. Initialization is started by confirming the tire inflation pressures.

Do not initialize the system when driving with snow chains.

Via iDrive:

1. "My Vehicle"
2. "Vehicle status"
3. "Flat Tire Monitor"
4. Switch on drive-ready state and do not drive off.
5. Start the initialization with: "Perform reset"
6. Drive away.

The initialization is completed while driving, which can be interrupted at any time.

The initialization automatically continues when driving resumes.

Messages

General information

When a flat tire is indicated, DSC Dynamic Stability Control is switched on, if needed.

Safety information

Warning

A damaged regular tire with low or missing tire inflation pressure impacts handling, such as steering and braking response. Run-flat tires can maintain limited stability. There is a risk of accident. Do not continue driving if the vehicle is equipped with normal tires. Follow the information on run-flat tires and continued driving with these tires.

Indication of a flat tire

(!) A yellow warning light is illuminated in the instrument cluster.

In addition, a symbol with a Check Control message appears on the Control Display.

Symbol	Possible cause
(!)	There is a flat tire or a major loss in tire inflation pressure.

Measure

1. Reduce your speed and stop cautiously. Avoid sudden braking and steering maneuvers.
2. Check whether the vehicle is fitted with normal tires or run-flat tires.

   Run-flat tires, refer to page 281, are labeled with a circular symbol containing the letters RSC marked on the tire's sidewall.

Actions in the event of a flat tire

Normal tires

1. Identify the damaged tire.

   To do this, check the tire inflation pressure in all four tires, for instance using the tire pressure gage of a flat tire kit.

   If the tire inflation pressure in all four tires is correct, the Flat Tire Monitor may not have been initialized. In this case, initialize the system.

   If identification of flat tire damage is not possible, please contact a dealer's service center or another qualified service center or repair shop.
2. Repair the flat tire, e.g., with a flat tire kit or by changing the wheel.

Run-flat tires

Safety information

Warning

Your vehicle handles differently with a run-flat tire with no or low inflation pressure; for instance, your lane stability when braking is reduced, braking distances are longer and the self-steering properties will change. There is a risk of accident. Drive moderately and do not exceed a speed of 50 mph/80 km/h.

Maximum speed

You may continue driving with a damaged tire at speeds up to 50 mph/80 km/h.

Continued driving with a flat tire

Follow the following when continuing to drive with a damaged tire:

1. Avoid sudden braking and steering maneuvers.
2. Do not exceed a speed of 50 mph/80 km/h.
3. Check the tire inflation pressure in all four tires at the next opportunity.

   If the tire inflation pressure in all four tires is correct, the Flat Tire Monitor may not have been initialized. In this case, initialize the system.

Possible driving range with a depressurized tire

The distance for which it may be possible to drive safely varies depending on how the vehicle is loaded and used, e.g., speed, road conditions, external temperature. The driving range may be less but may also be more if an economical driving style is used.

If the vehicle is loaded with an average weight and used under favorable conditions, the distance for which it may be safe to drive may be up to 50 miles/80 km.

Vehicle handling with damaged tires

Vehicles driven with a damaged tire will handle differently, potentially leading to conditions such as the following:

- Greater likelihood of swerving off course.
- Longer braking distances.
- Changed self-steering properties.

Modify your driving style. Avoid abrupt steering maneuvers or driving over obstacles, for instance curbs or potholes.

Final tire failure

Vibrations or loud noises while driving can indicate the final failure of a tire.

Reduce speed and stop; otherwise, pieces of the tire could come loose and cause an accident.

Do not continue driving. Contact a dealer's service center or another qualified service center or repair shop.

System limits

The system could be delayed or malfunction in the following situations:

- A natural, even tire inflation pressure loss in all four tires will not be recognized. Therefore, check the tire inflation pressure regularly.
- Sudden serious tire damage caused by external circumstances cannot be recognized in advance.
- When the system has not been initialized.
- When driving on a snowy or slippery road surface.
- Sporty driving style: spinning traction wheels, high lateral acceleration (drifting).
- When driving with snow chains.

Changing wheels/tires

General information

When using run-flat tires or a flat tire kit, a wheel does not always need to be changed immediately when there is a loss of tire inflation pressure due to a flat tire.

If needed, the tools for changing wheels are available as accessories from a dealer's service center or another qualified service center or repair shop.

Safety information

DANGER

The vehicle jack is only provided for short-term lifting of the vehicle for wheel changes. Even if all safety measures are observed, there is a risk of the raised vehicle falling, if the vehicle jack tips over. There is a risk of injuries or danger to life. If the vehicle is raised, do not lie under the vehicle and do not start the engine.

DANGER

Supports such as wooden blocks under the vehicle jack reduce the capacity of the vehicle jack to bear weight. They have the potential to exert too much strain on the vehicle jack, causing it to tip over and the vehicle to fall. There is a risk of injuries or danger to life. Do not place supports under the vehicle jack.

Warning

The jack, issued by the vehicle manufacturer, is provided in order to perform a wheel change in the event of a breakdown. The jack is not designed for frequent use; for example, changing from summer to winter tires. Using the jack frequently may cause it to become jammed or damaged. There is a risk of injury and risk of damage to property. Only use the jack to attach an emergency or spare wheel in the event of a breakdown.

Warning

On soft, uneven or slippery ground, for example snow, ice, tiles, etc., the vehicle jack can slip away. There is a risk of injury. If possible, change the wheel on a flat, solid, and slip-resistant surface.

Warning

The vehicle jack is optimized for lifting the vehicle and for the jacking points on the vehicle only. There is a risk of injury. Do not lift any other vehicle or cargo using the vehicle jack.

Warning

If the vehicle jack is not inserted into the jacking point provided for this purpose, the vehicle may be damaged or the vehicle jack may slip when it is being cranked up. There is a risk of injury or risk of damage to property. When cranking up the vehicle jack, ensure that it is inserted in the jacking point next to the wheel housing.

Warning

A vehicle that is raised on a vehicle jack may fall off of the jack if lateral forces are exerted on it. There is a risk of injury and risk of damage to property. While the vehicle is raised, do not exert lateral forces on the vehicle or pull abruptly on the vehicle. Have a stuck wheel removed by a dealer's service center or another qualified service center or repair shop.